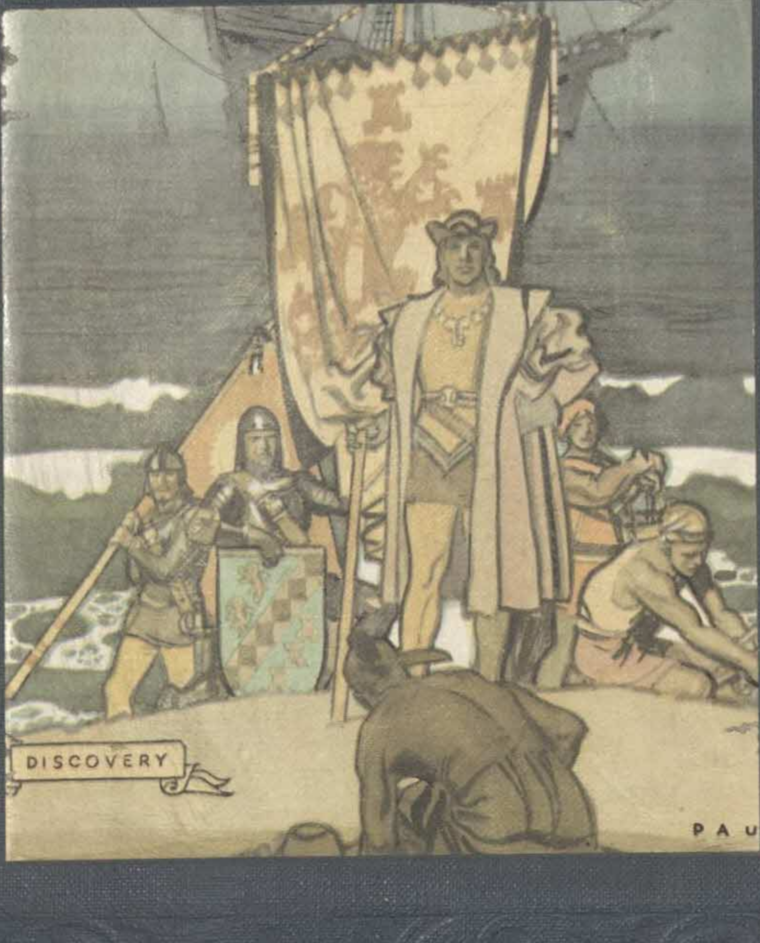
THE WONDERLAND OF KNOWLEDGE



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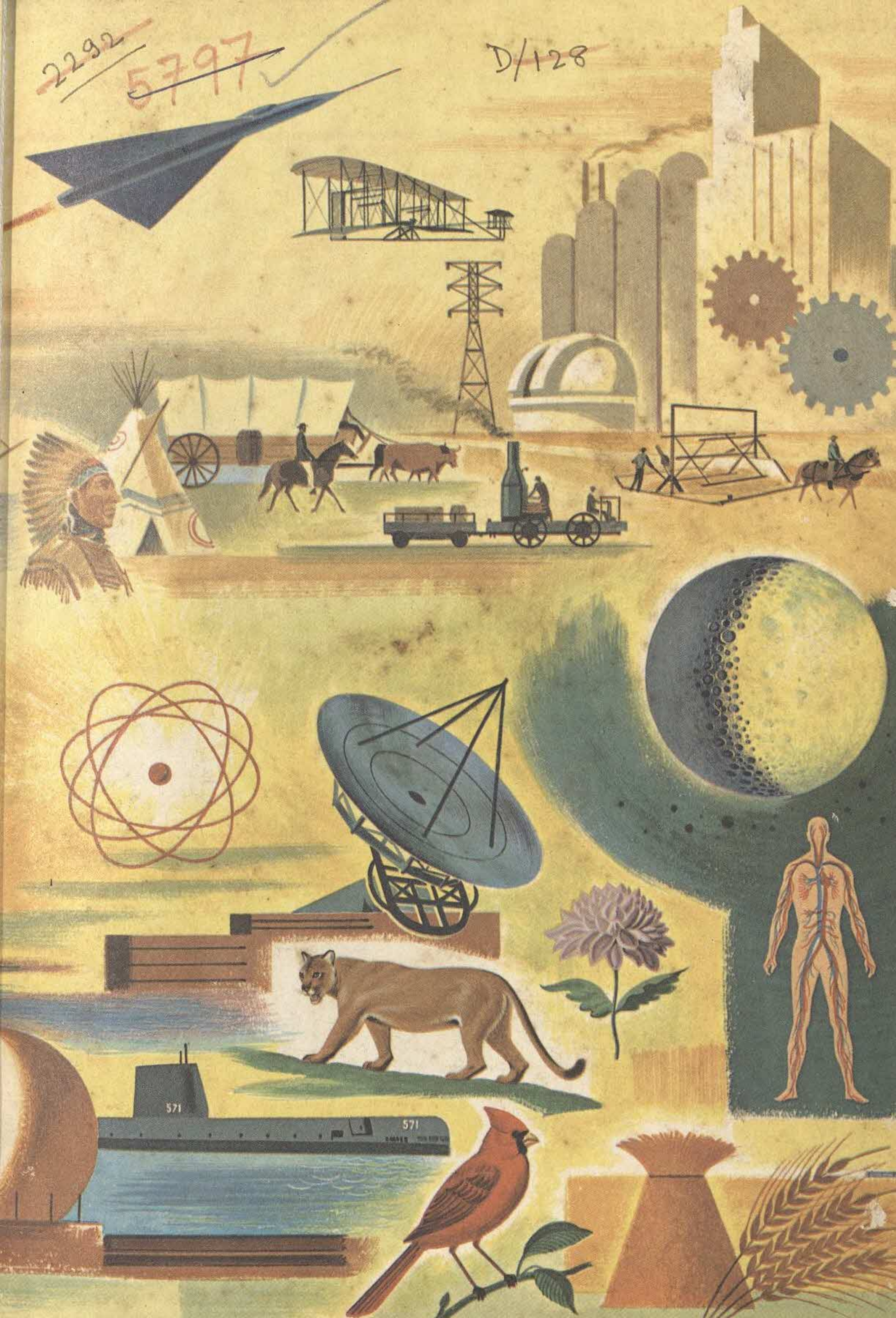

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THE WONDERLAND OF KNOWLEDGE

TRAINING COLLEGE
HAMIRPUR.

The Pictorial Encyclopedia

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1961

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PRONUNCIATION

The pronunciation of titles is indicated by accenting the word or by respelling it phonetically in italics. In the phonetic spelling, letters are used to indicate the sounds which they most commonly represent.

A vowel is *short* when followed by a consonant in the same syllable, unless the syllable ends in silent *e*.

A vowel is *long* when the letter occurs in a syllable which ends in silent *e* or when ending an accented syllable.

The hard sound of *c* is represented by *k*.

The hard sound of *s* is represented by *z*.

The foreign sounds which have no equivalent in the English language are represented as follows:

N for the French *n*, as in Breton: (**Breton,** *bre toN'*).
ö for the German *ö*, as in Göttingen: (**Göttingen,** *gö' ting en*).
ü for the German *ü*, as in Blücher: (**Blücher,** *blük'ur*).

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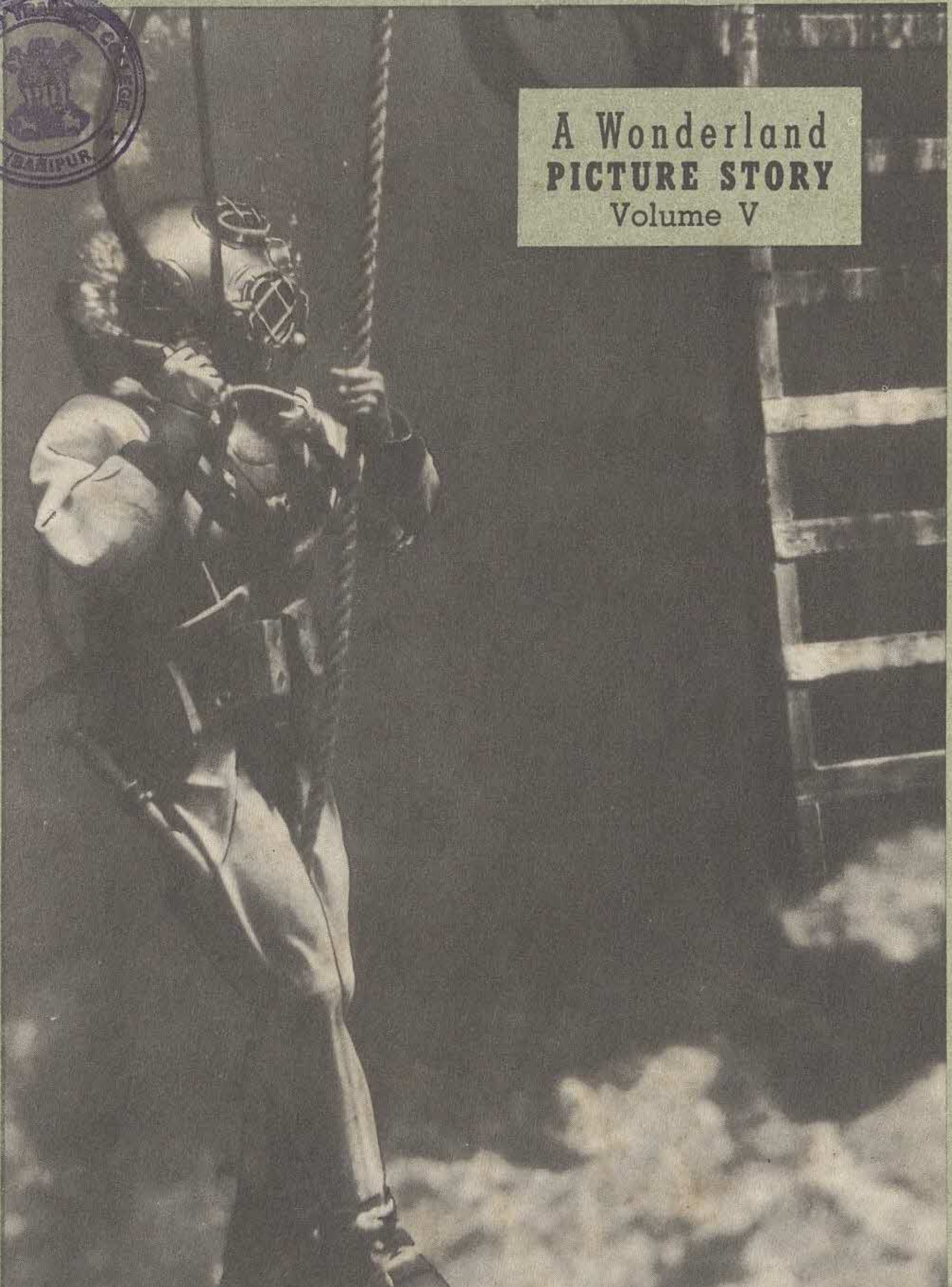
SENIOR BASIC TRAINING COLLEGE BANIPUR

A Wonderland
PICTURE STORY
Volume V



Official U.S. Navy Photograph

DIVING. Some 200 pounds of rubber and metal make up the diving suit of this salvage worker. A two-way telephone is part of his equipment. See page 1226.

Things we learn from Volume V

Why did man turn to factories to produce goods?

In the late 1700's, special machinery run by water power and steam replaced hand tools used by people in work in their homes. Companies with sufficient money to buy this machinery set up special places of work called *factories*. See FACTORY AND FACTORY LEGISLATION.

How is electricity transmitted with a minimum of waste over great distances?

For long-distance transmission, electricity is sent out over the main lines at high pressures. Then, with the aid of transformers, the electrical pressure is reduced to the amount necessary for local service. See ELECTRICITY.

Why is the Elizabethan Era sometimes referred to as England's "Golden Age"?

In the reign of Elizabeth, English literature rose to its greatest heights through the dramas of Shakespeare, the poetry of Edmund Spenser, and the essays of Francis Bacon. English mariners and the East India Company paved the way for a vast colonial empire. Spain was destroyed as a sea power and England took its place. Protestantism was permanently established in England. When Elizabeth became queen, England was a medieval country. When she died it was a modern nation. See ELIZABETH.

What relationship is there between our alphabet and the early caveman's primitive drawings?

Both the drawings of early man and our alphabet are means of expression and communication. The ancient caveman drew pictures of the hunt before the invention of the alphabet; thus drawing took the place of writing. The Phoenicians developed our formal alphabet from the Egyptian word pictures, the hieroglyphics. See DRAWING.

What is the importance of the "Fertile Crescent" in world history?

The "Fertile Crescent" comprises the area of the valleys of the Tigris and Euphrates rivers in modern Iraq, and extends to the eastern shore of the Mediterranean in modern Syria. This exceptionally fertile area gave rise to important ancient empires such as Assyria, Chaldea, and Babylonia. Their influence was felt throughout the East and at one time much of Asia Minor and Western Asia were under their control. In this area, the arts and sciences flourished, and here were developed many of the scientific and mathematical principles which are so important to us today. See EUPHRATES.

Why do farmers often plant grass, hay, or small grains on sloping areas of land?

This planting is done to prevent the erosion of the soil. Erosion is a process whereby the soil is carried away by natural causes, such as wind, rain, ice, or sea waves. As erosion increases, not only does the farmer lose the valuable top soil in which he must grow his crops, but the land may become so broken up and rutty that he will be unable to till it. See EROSION.

How does the elephant of India pick up a peanut?

This elephant has two finger-like projections inside the tip of the trunk. With the aid of these, the elephant is able to pick up very small articles. See ELEPHANT.

What is dry farming?

In areas where the annual rainfall varies between ten and twenty inches, farmers must resort to dry farming to maintain their crops. It consists of deep plowing in the fall, so that winter rains and snow may soak into the ground, followed in spring by methods which reduce the top soil to a fine dust. The dust blanket holds the moisture in the ground, where it is used by the growing crop. See DRY FARMING.

How do sand dunes march?

The action of the wind drifts loose sand over the neighboring area. As the process continues, the remaining sand is blown over the new dune to the leeward side until the entire dune has been moved. See DUNE.

What makes the brilliant colors of sunrises and sunsets?

Atmospheric dust is the chief cause of this phenomenon. As the light of the sun shines through various dust particles, colorful pictures are produced. See DUST, ATMOSPHERIC.

Who was Dred Scott?

Scott was a Negro slave who sought his freedom after he had lived in a free territory for two years. The Supreme Court of the United States held that he was a slave and not entitled to the rights of a citizen. The incident was important in the events leading to the Civil War. See DRED SCOTT DECISION.

What is the source of the modern term dictator?

The title originated in Roman history. Dictators, with complete authority over the citizens, were often appointed in times of danger. See DICTATOR.

The Home of a HARDY RACE

DEN'MARK. A land of farms and fisheries, the kingdom of Denmark is almost entirely surrounded by the sea. Smallest and southernmost of the three Scandinavian countries, Denmark embraces the northern section of the Jutland Peninsula and several island groups, of which the most important and largest lie to the east in the Baltic Sea.

Denmark's one land connection is on the south; less than forty miles long, it is the boundary between the country and Germany. The North Sea separates Denmark from Great Britain on the east; on the north, Denmark and Norway are separated by the Skagerrak, an arm of the North Sea; the Kattegat, another arm of the same ocean, lies between the kingdom and Sweden.

Denmark has an area of 16,575 square miles, and is about one third the size of New York state. It has a population of about 4,529,000.

The large islands of Denmark are Fünen and Zealand, on which Copenhagen, the capital, is situated. The colonies are Greenland and the Faroe, or Faeroe, Islands, which lie to the north of the British Isles. The three islands comprising the Danish West Indies were sold to the United States in 1917. Iceland, a former possession, was recognized as a sovereign state in 1918, and was united with Denmark only through the identity of the sovereign. In 1940, when Germany invaded Denmark, Iceland declared itself free of all Danish ties. The Faroe Islands were occupied by British forces as a protective measure.

In this uniformly low country, the highest point, 600 feet, is found in the range of hills in the center of Jutland. The plains of the west are mostly dunelands which have been reclaimed for crop or timber cultivation. The level east coast is marked by many fjords, rich arable lands and beech forests. Of the many inland bodies of

Danish National Travel Office

DENMARK'S LITTLE MERMAID

The statue of the little mermaid in a Hans Christian Andersen story looks out to sea. This is a favorite attraction for children in Copenhagen.

water — small lakes and streams — the Guden River, about eighty miles long, is the largest.

A Land of Farms. Denmark is primarily an agricultural country, with more than one-third of her people engaged in farming. Ninety-two per cent of the farmers own their farms and consequently are interested in keeping the land fertile, so that it will continue to produce. As one of the chief problems of the farmers was to convert their waste land into good farming land, the farmers of Denmark organized the Danish Heather Society in 1866, to direct the work of land reclamation and reforestation. River courses have been straightened, bogs and marshes drained, and thousands of acres of moorland converted into fertile farms by the use of fertilizers, irrigation, terracing, and other farm practices.

Each year the Danes raise more than 5,000,000 tons of potatoes, wheat, rye, barley, and oats. They also raise large crops of sugar beets, beans, and hay. The success of the soil-improvement program in Denmark is shown by the fact that the average production of wheat per acre is very high.

Denmark is a country where people work together for the good of all. They have organized co-operative societies in order to provide markets for their products and to help purchase their food and other supplies at lower prices. The producers of bacon, lard, poultry, butter, and eggs have the largest co-operative and sell their goods all over the world. The spirit of co-operation made Denmark a prosperous country. Today there are more than 200,000 farms in Denmark.

Industry and Trade. Although there is no single great industry in Denmark, manufacturing is increasing in importance. Porcelain is made extensively in Copenhagen, and other manufactures include furniture and woolen, linen, and cotton goods. There are also a number of sugar-beet refineries. Fishing is an important industry, the country's fishing fleet usually numbering 15,000 vessels. Practically all of them are worked by their owners and a crew of two or three men.

The Danes normally carry on a large shipping industry, and Copenhagen, the capital, is their most important seaport. About three quarters of a million people live in Copenhagen, which is a great commercial center, as well as the capital.

Government. Denmark's government is a monarchy. It is governed by the Constitution of 1953, which provides for executive, legislative, and judicial branches. Executive power lies with the king, who exercises his authority through a State Council of thirteen ministers. Legislative power is held jointly by the king and the *Folketing,* which consists of one chamber of 179 members. *Folketing* members are elected for a term of four years. Men and women are eligible to vote on reaching the age of twenty-three if they have permanent places of residence.

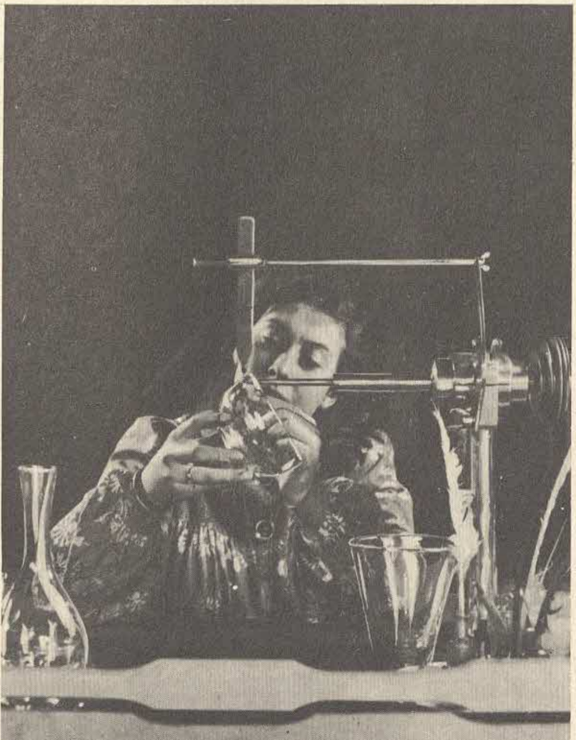
Education and Religion. Education is free in Denmark and school attendance is compulsory for boys and girls between the ages of seven and fourteen years. Until the middle of the last century, education was given only to the aristocratic classes, but under the leadership of Bishop Grundtvig, schools for the common people were established. Among the features of the Danish school system are the people's high schools, which are open to all people over eighteen years old. In addition to the Royal Academy of Arts and several technical schools, the University of Copenhagen is the leading educational institution.

Lutheranism is the established religion, but all creeds are allowed to worship as they please. The king must be a member of the Established Church, but exercises no political control over religion.

History. Always a brave people, the inhabitants of the Scandinavian countries began to make themselves felt in Europe at

DANISH ARTS AND AGRICULTURE
Right, Denmark is a rich dairy land, much like Wisconsin. Left, modern Denmark is noted for its beautifully designed glassware.

Danish National Travel Office



the beginning of the Christian Era. Continually raiding the coasts of Europe, the Danes conquered Normandy, invaded England in the ninth century, and even sailed their ships as far as America. Although a Danish king accepted the Christian religion in 826, it was not until the time of Canute, who conquered England, that Christianity gained a foothold in Scandinavia. Following the death of Canute, in 1035, Denmark, ruled by a series of weak kings, went through three centuries of upheaval.

In 1397, Margaret, queen of Denmark and Norway, joined the two countries and Sweden under the Union of Kalmar, which lasted until 1523, when Sweden withdrew. In 1814, by the Peace of Kiel, Frederick VI of Denmark was compelled to cede Norway to Sweden. In 1864, following a brief war with Austria and Prussia, Denmark lost Holstein and Schleswig. Not until 1920, after the World War, did the Danes regain any of this territory. Then, after a vote of the people, a part of Northern Schleswig was restored to Denmark.

Denmark succeeded in maintaining her neutrality during World War I, but found herself in a more serious condition in the Second World War, when, from April, 1940, to May, 1945, German troops occupied the country. Although King Christian had accepted the invasion without protest, because of his nation's lack of defense, the Danish people showed their opposition to occupation by constant acts of sabotage and resistance. See COPENHAGEN; FAROE ISLANDS; GREENLAND; ICELAND.

DEN'SITY. If a pan is filled to the brim with cold water, covered, and placed over the fire, the water will soon overflow. The pan will still be full, yet it will contain less water than before. The heated water is said to be less dense than the cold, because there is less of it in any given space. The *density* of any substance is the relation of its mass to its volume. Thus the density of pure water at a temperature of 4°C. (39.2°F.) is one gram per cubic centimeter, or 62.425 pounds per cubic foot.

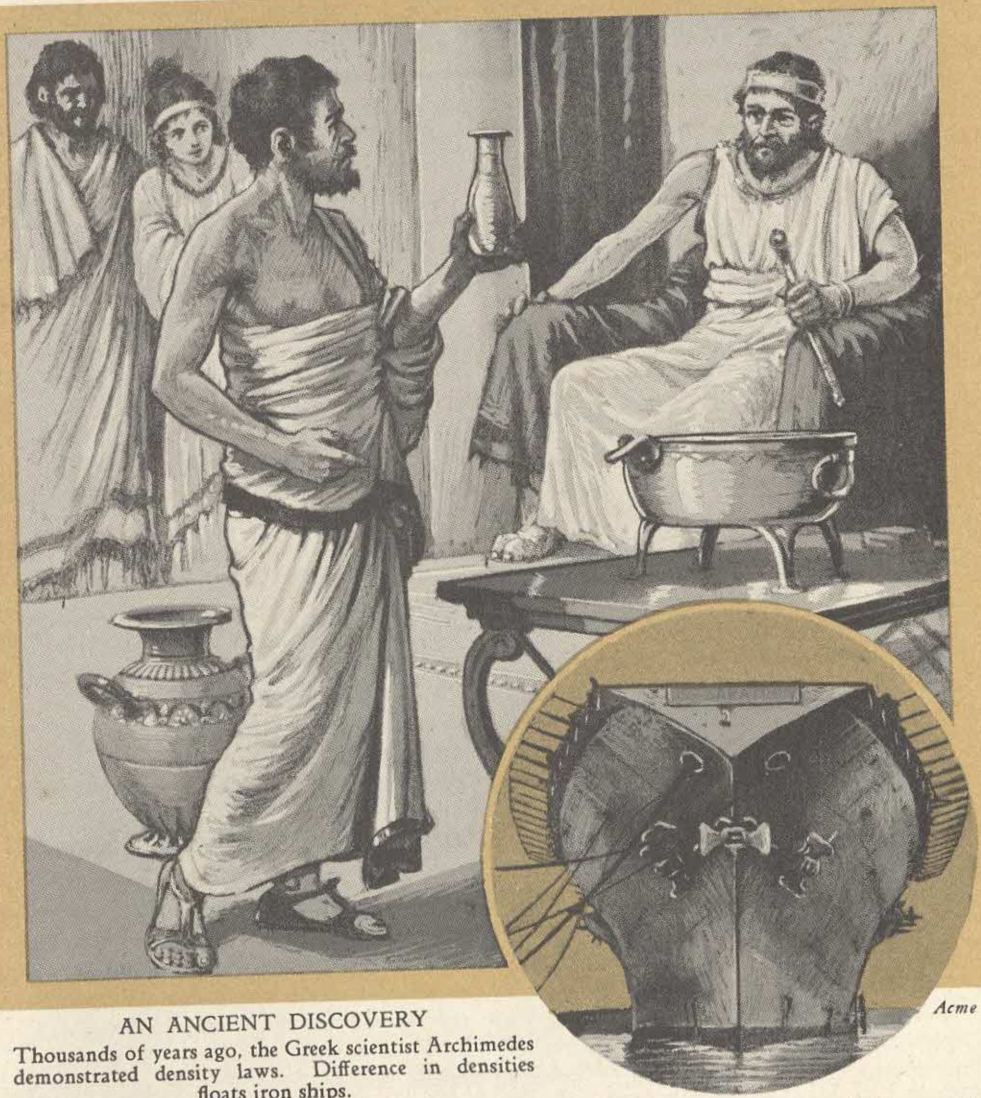
Specific Gravity. In the metric system, used by scientists, the units of mass are based on the mass of water. Because water at its greatest density has a mass of one gram per cubic centimeter, if it is said that the density of silver is 10.5 grams per cubic centimeter, we know at once that silver is ten and one-half times as dense as water. But in our English system, the density of silver would be given as 655.46 pounds per cubic foot. As this figure gives no indication of the proportion of its density to that of water—and it is often convenient to know this proportion—we express it by saying that the specific gravity of silver is 10.5.

Thus, when the specific gravity of vinegar is given as 1.02 and that of gasoline as 0.67, we understand that vinegar is slightly more dense than water and gasoline about two-thirds as dense. When the specific gravity of a gas (as, for instance, helium, with which dirigible balloons are filled) is given, the comparison is usually with air at the same pressure. Thus, hydrogen is said to have a specific gravity of 0.0695, which means that it is about .07 as dense as air.

It should be noted that specific gravity may be expressed by a simple number, because it is a numerical ratio. But density must have the more complete expression. The specific gravity of milk is about 1.03, but its density is 1.03 grams per cubic centimeter, or about 64.3 pounds per cubic foot.

Ascertaining Density. When Archimedes was ordered by the king of Syracuse, about 230 B. C., to find out whether the royal crown was all of gold or was only gold on the outside, it is said that the scientist was at first unable to give an answer. Then one day, while in the bath, he noticed that he felt as though lifted up by the water. According to tradition, he hurriedly emerged and ran down the street crying "Eureka!" (I have found it!)

What he discovered was that an object sunk or floating in a liquid seems to weigh less than it does in air, and that the apparent difference in weight equals the weight



Acme

AN ANCIENT DISCOVERY
Thousands of years ago, the Greek scientist Archimedes demonstrated density laws. Difference in densities floats iron ships.

of the water which the object displaces. How Archimedes' discovery is used to determine the density of various liquids is told in the article HYDROMETER.

The Importance of Density. Most wood floats on water; heavy woods sink. Solid iron or steel sinks, yet steel ships and concrete floating dry docks are seaworthy. Balloons filled with heated air, or dirigibles inflated with helium, ascend into the atmosphere. Oil poured on vinegar floats, but vinegar poured on oil sinks. All of these familiar phenomena result from differences in density, and so it is plain that a knowledge of the density of a substance is often needed for one to tell how the substance will act under given conditions.

Density is sometimes a measure of efficiency. High-test gasoline has low density, because it is relatively free from impure substances. The density of milk is in general an indication of the amount of fat it contains, cream being less dense than milk. See CHEMISTRY; GRAVITY, SPECIFIC.

FOR GOOD HEALTH—SOUND TEETH
This bright-eyed child has fine teeth—and dentistry will keep them that way.

DEN'TISTRY. Nothing in personal hygiene or care of the body is of more importance than the proper care of the teeth and mouth, or dentistry. Today a highly perfected science and art, dentistry was practiced to some extent by some of the oldest civilized peoples, including the early Egyptians. No country in the world, however, has ever developed dentistry so successfully as has the United States. There, dentistry is one of the most important divisions of medical science.

Regular visits to a reliable dentist should be a part of the habits of everyone. In the end, such visits are much less expensive than occasional visits at long intervals, for prevention is always cheaper than cure. In addition, scrupulous cleanliness of the teeth and mouth will aid in preventing decay of the teeth.

Few people realize the immense importance of mouth hygiene in relation to general health, but physicians and dentists believe that many serious diseases originate in dental infections. For example, abscesses at the roots of the teeth often cause no pain and give no symptoms which are recognized. Yet they may be, and often are, the cause of rheumatism, anemia, neuritis, headache, heart disease, and a good many other serious troubles.

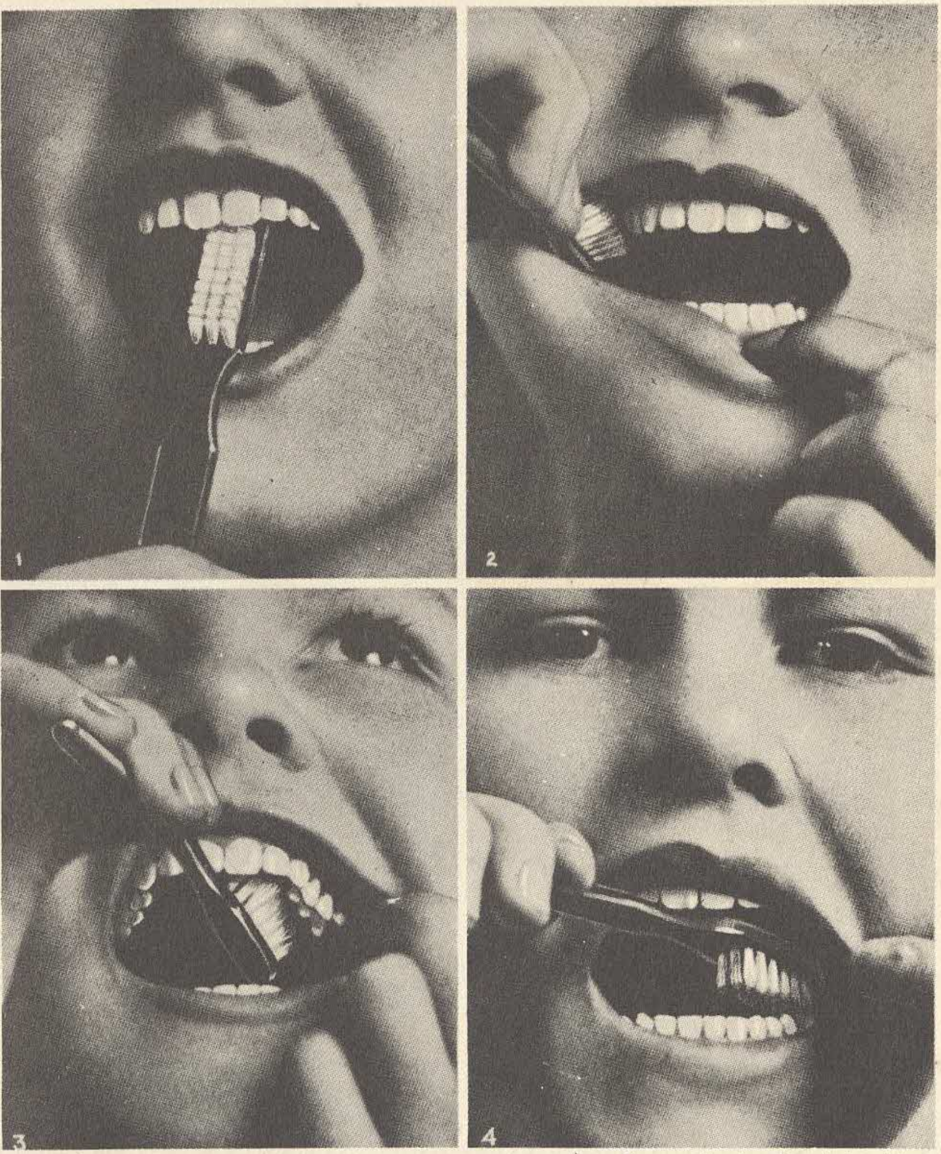
The Practice of Dentistry. Dentistry, like medicine and surgery, is becoming so complicated that it is now common for dentists to specialize in some branch of their profession. The chief branches are general dental practice, orthodontia, oral surgery, prosthodontia, periodontia, pedodontia, and dental public health.

Most dentists are concerned with general dental practice. They clean and scale teeth, take mouth X-rays, fill cavities, fit bridges and dentures, extract teeth, and treat pyorrhea and other mouth diseases. In short, the general practitioner does all he can to preserve the patient's teeth. Orthodontia is the branch of dentistry concerned with correcting such abnormalties as irregular teeth. This is usually accomplished with the aid of braces and similar appliances. In most cases it is best to have mouth and teeth defects corrected during childhood.

Oral surgery deals with the extraction of teeth and other surgery of the jaws and mouth parts. Prosthodontia is the phase of dentistry that includes the construction of bridgework and dentures. Dentists who specialize in the treatment of diseases of the gums are called periodontists, while those who confine themselves to the dental care of children are known as pedodontists. Dental public health is the education of the public concerning the problems of dental health.

DEN'VER, Colo. This "mile-high city" at the foot of the towering Rocky Mountains is the capital of Colorado. It is the most important city in size and commerce between Kansas and California. Geographically, it lies almost midway between Chicago and San Francisco. Because of its location and altitude, it is famed not only for its natural beauty, but for its healthful climate. The sun shines in Denver much of the year, and neither the summers nor the winters are extreme.

Denver was at first two small villages, Auraria and Saint Charles, built in 1858 on Cherry Creek. Shortly after, however,



Courtesy American Dental Association

GOOD TEETH ARE WELL WORTH GOOD CARE

There is a right and a wrong way to brush your teeth. Here dentistry shows us how it should be done. (1) The inside of the front teeth: Starting with the bristles on the gums, brush these teeth downward with a rolling motion, over the necks of the teeth to the biting surfaces. Repeat the motion at least ten times. (2) The cheek surfaces of the back teeth: The bristles should rest on the gums over the upper last teeth and point upward. Partly close the mouth and firmly roll the bristles down over the gums and teeth toward the grinding surface. Slowly work the brush forward to the front teeth. Ten times here, too. (3) Inside surfaces of back teeth: Start with the brush well back in the mouth and with its bristles well up on the gums, pointing slightly up. Use the rolling or sweeping downward stroke over the necks of the teeth to the grinding surface. Move the brush slowly forward in the mouth. Ten times again. (4) Brushing the grinding or biting surfaces: Food particles which catch in the broad, uneven surfaces of the teeth must be brushed away. With the bristles held firmly against the surfaces, move the brush with a backward and forward and side-to-side motion, forcing the bristles well into the deep grooves of the back teeth. Repeat rapidly at least twenty-five times.

QUEEN OF SILVER
Denver, the beautiful mountain capital of Colorado, is the center of the state's great silver-mining industry. The metropolis is laid out with many broad avenues and parks. (1) Airplane view of the Civic Center, mall, and Capitol. (2) Seventeenth Street has the mighty Rockies for a background. (3) Civic Center plaza.

the two villages became one. This was named for General J. W. Denver, governor of the Kansas Territory. Colorado was at that time included in the territory.

Since then, Denver has grown into a city with broad, shaded streets, attractive homes, beautiful parks, and numerous schools. Its public-school system is one of the finest in the United States; the University of Denver and several colleges provide higher education.

With seven railroads serving the city, a large airport, and a central location, it is little wonder that Denver is a commercial center. Since it is located in a mining, agricultural, and cattle-raising region, much of its industry is in ore smelters, in manufacturing and railroad construction, in grain trading and milling, in sugar refining, and in the maintenance of stockyards and meat-packing houses.

Pride of the people of Denver is the Civic Center, built around the $2,800,000 state capitol, with its handsome golden dome. Among other notable buildings in Denver are the United States Mint, the United States Customs Building, the Union Depot, the Federal Building, and an auditorium which seats 12,000 people. The population of Denver is about 495,000.

DER'RICK. The common windlass used to raise dirt or water from a well is a simple example of a derrick. This lifting machine, very important in building construction, is a type of crane, the purpose of which is to raise heavy objects and move them short distances. Oil derricks, those familiar black towers seen in oil fields, raise and lower the drill used in boring.

Commonly, the derrick is a tall mast or pole with guy ropes attached to the top and anchored to the ground. The foot of the pole is fitted into a socket. A boom, or another pole, is attached to the center mast a

Baltimore & Ohio R.R.

CAUGHT IN A STEEL WEB

Steel cables support the weight of a railroad car, hoisted by a derrick onto a waiting freighter.

few feet off the ground, and can have its upper end raised or lowered. The boom contains the tackle blocks used in lifting. From the tackle block, ropes run to the winding mechanism at the base. The weight is moved by turning the mast in the socket, thus swinging the boom around.

DESCARTES, *da kahrt′,* RENÉ. See PHILOSOPHY.

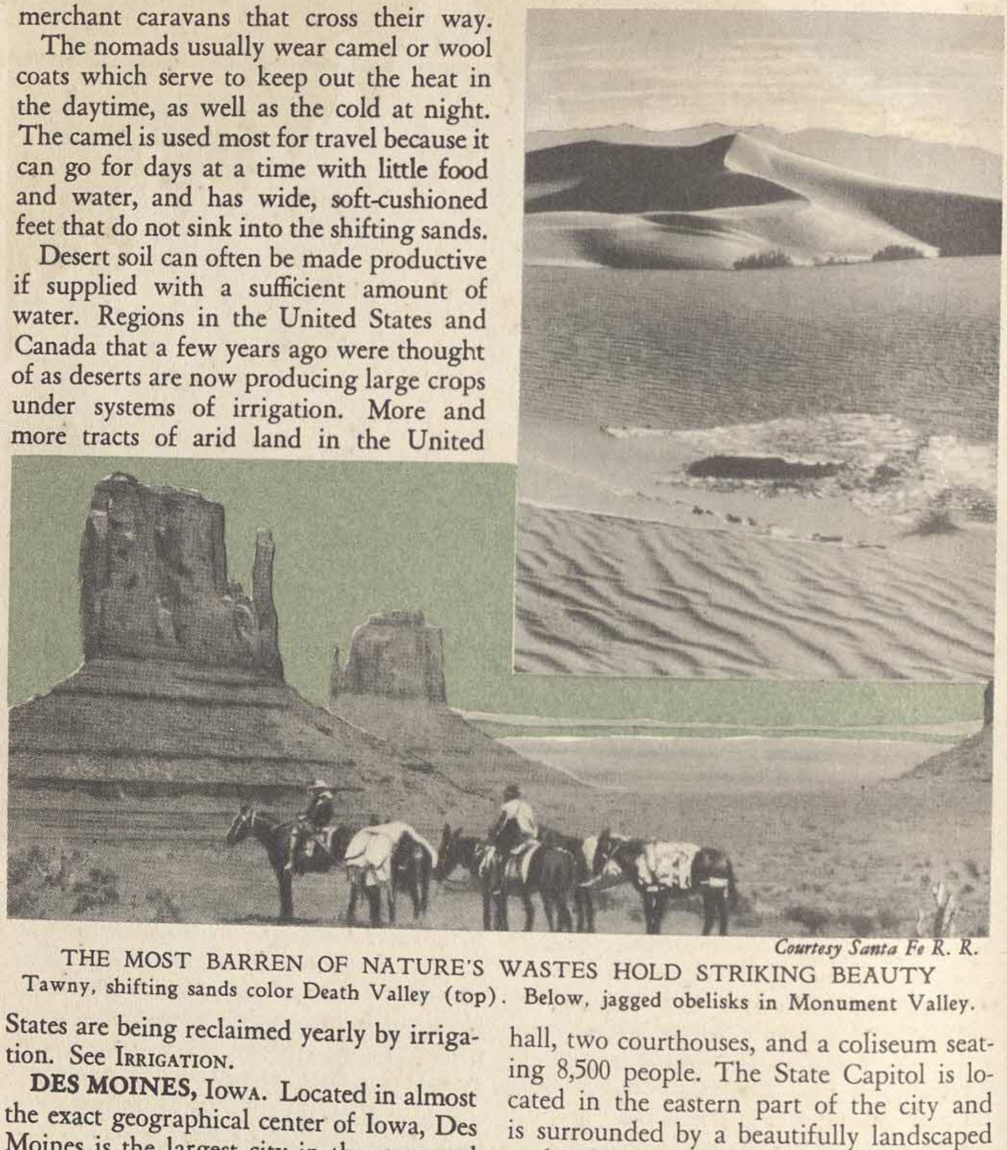
DESERT. A vast, arid expanse of ever-shifting sand hills, their bareness dotted with widely spaced gray plants—this is the typical desert, fiercely hot while the sun shines, but bitterly cold at night. Many of the sand deserts of the world lie in the trade-wind belt, over which northeasterly winds move toward the equator, constantly becoming warmer and absorbing all the moisture in their paths. They form trade-wind deserts like the great Sahara of Northern Africa, which is larger than the United States.

The desert regions of North and South America are examples of those that occur on the leeward side of mountains. The westerly winds of the Pacific lose their moisture as they rise to cross the west-coast mountains; and when they reach the leeward side, they are very dry and hot. As a result, deserts are formed which receive little or no rain for years at a time.

Oases, small areas near streams or springs, occur mostly in deserts nearest the equator and provide a home for man. Here he can grow rice, cotton, or millet and trade with the caravans. Nomadic groups live on the margin of the desert and drive their scanty flocks back and forth in search of pasturage. Because worth-while land is so scarce, these tribes are very warlike, defending their valuable pasture lands and robbing the settlements of the oasis or any merchant caravans that cross their way.

The nomads usually wear camel or wool coats which serve to keep out the heat in the daytime, as well as the cold at night. The camel is used most for travel because it can go for days at a time with little food and water, and has wide, soft-cushioned feet that do not sink into the shifting sands.

Desert soil can often be made productive if supplied with a sufficient amount of water. Regions in the United States and Canada that a few years ago were thought of as deserts are now producing large crops under systems of irrigation. More and more tracts of arid land in the United States are being reclaimed yearly by irrigation. See IRRIGATION.



Courtesy Santa Fe R. R.

THE MOST BARREN OF NATURE'S WASTES HOLD STRIKING BEAUTY
Tawny, shifting sands color Death Valley (top). Below, jagged obelisks in Monument Valley.

DES MOINES, IOWA. Located in almost the exact geographical center of Iowa, Des Moines is the largest city in the state and one of the important industrial centers of Middle Western United States. It extends along both banks of the Des Moines River at the mouth of the Raccoon. The city is the capital of Iowa and the county seat of Polk County.

Des Moines was one of the first cities in the United States to plan for beauty in its development. Along the riverbanks and extending through the heart of the city is the Civic Center, in which stand the city hall, two courthouses, and a coliseum seating 8,500 people. The State Capitol is located in the eastern part of the city and is surrounded by a beautifully landscaped park of ninety-three acres.

Des Moines is the great wholesale center for the Corn Belt region. It is a leading American center for the distribution of farm implements, and its meat-packing industry is largely supplied by the famous corn-fed hogs of Iowa. Other important manufactures include chemicals, cosmetics, clothing, flour, and machine-shop products. A mining industry is based on coal deposits found near by. Over fifty insurance companies have home offices in Des Moines.

A SPANISH CONQUEROR CROSSES THE FATHER OF WATERS

Fernando De Soto discovered the Mississippi River in 1541, while he and his men were searching for gold. They crossed into what is now Arkansas, Oklahoma, and Texas, but found no gold. Disappointed, they turned back, and De Soto died on the river's bank.

The city is the home of Drake University, a private coeducational school.

The history of the city dates from the building of Fort Des Moines in 1843 to protect the rights of the Sacs and Foxes. In the same year the district was opened to white settlers and in 1846 the town was laid out. In 1857 the city received its charter and was also made the capital of the state. Since 1907 Des Moines has been governed under the "Des Moines Plan," a modified commission form of government which has been widely copied. The plan calls for a council of five men, each of whom is in charge of a special department, to handle the affairs of city government. The city's population is about 210,000.

DE SOTO, *soh'toh,* FERNANDO (1500?-1542). Cotton fields and cornfields, steel mills and coal mines stand today in the southern part of the United States where once a Spanish adventurer wandered in search of gold and silver. This explorer was the daring and cruel Fernando De Soto, whose tragic expedition to North America gave Spain a claim to Florida, Louisiana, and a vast area west of the Mississippi River.

When still a youth, De Soto came to the New World to seek his fortune, taking part in an expedition in Nicaragua, where he believed there was a waterway connecting the Atlantic and Pacific oceans. In 1532 he accompanied Pizarro to Peru, where the riches of the Incas brought wealth to the white men. Obtaining the fortune he had come to seek, he went back to Spain, only to return to Cuba as governor of that island and Florida.

No one knew much about Florida; so De Soto decided to explore it and to search for the gold the Spaniards thought was there. With a small army he set sail for Florida and landed at Tampa Bay in May, 1539. No white man had ever seen the country to the north; so De Soto led the way through the dense wilderness. Up through the hills of the Appalachians the band went, meeting trouble from the Cherokee and Seminole Indians who feared the strange white men.

One by one De Soto's men died from exposure and the constant warfare with the Indians, but on he went. He turned south and reached Mobile Bay, then went northwest again to a point near Memphis where he discovered and crossed the Mississippi River in 1541. The rapidly diminishing band then went south, across the Arkansas River and across the Red River. Finally, in June, 1542, De Soto became ill and died, and his companions buried him at night in the great Mississippi River.

The little band of men struggled on without their leader, reaching the Gulf of Mexico again, half-starved, bedraggled, poor, and empty-handed. They finally found a Spanish settlement in Mexico.

DETROIT′, Mich. Known the world over as the motor city, Detroit is the fifth largest city in the United States and is the commercial center of Michigan. It has grown to its present size and importance with the development of the automobile. Although numerous automobile-producing centers are springing up all over the world, Detroit still maintains its leadership in the United States and the world. The population of the city is about 1,690,000, and the population of its metropolitan area is about 3,799,000.

Commerce and Industry. Detroit is situated on a narrow straitlike river connecting Lake Erie and Lake Saint Clair. For this reason it is known as the "City of Straits." It extends for eleven miles along the Detroit River, and is built on ground gently sloping away from the bank. The river front is lined with wharves, elevators, and warehouses which receive raw materials brought from the iron region of Lake Superior and the coal fields of Pennsylvania. The river is deep, forming a good harbor, and is one of the busiest in the world. Grain and other products of the West passing through make Detroit first among the ports of the northern border.

Aside from the automobile industry, Detroit is an important center for the manufacture of foundry products, tools, metal alloys, paints, and varnishes. The largest tire factory and leading drug-manufacturing house are located here. The establishment of the Great Lakes Steel Corporation in the Detroit area has made the city an important steel-manufacturing center. Other growing industries include the manufacture of refrigerators, oil burners, and air-conditioning equipment. More than fifty factories making airplanes and airplane parts are located in Detroit.

General Description. So great has been the growth of Detroit that the original plan for city development has long since been passed. In the older and central portions, the streets radiate as the spokes of a wheel from the semicircular plot of Grand Circus Park and from Campus Martius, another central point. In the newer sections the streets cross at right angles.

Detroit has more than forty-five parks, the most noted of which is Belle Isle, an island of over 700 acres in the Detroit River. It is laid out with beautiful walks and drives and contains a zoölogical garden, an aquarium, and a well-planned bathing beach. There are many other beautiful parks along the river and scattered throughout the city, the largest being River Rouge Park, having 1,200 acres.

Detroit also has many beautiful and imposing buildings. The General Motors Building is one of the largest office buildings in the world. Others include the Fed-

Edward B. Carter

DETROIT — INDUSTRIAL GIANT
Detroit as seen from Windsor, Canada. In the foreground is the Detroit River, broad water highway.

eral Building, the Ford Building, the Real Estate Exchange, the Masonic Temple, and the Michigan Central Station. Facing the city hall is the Soldiers' and Sailors' Monument, a granite shaft fifty-five feet high, surmounted by a colossal bronze statute representing Michigan. The city is also noted for its beautiful churches.

Education. The city has many outstanding educational and cultural institutions, among which are the Museum of Art, the University of Detroit, Michigan College of Medicine and Surgery, Detroit College of Law, the Detroit Institute of Technology, Wayne University, and Detroit Teachers College.

History. Detroit was first settled by the French under Cadillac in 1701 as a fortified trading post. It was the scene of many Indian wars. During the American Revolution, it served as headquarters for the British forces in the Northwest. In 1805 the place became the capital of Michigan Territory. In the War of 1812, it was captured by the British but regained by the Americans in the following year. Detroit was incorporated as a city in 1824. It was made the state capital when Michigan was admitted to the Union in 1837, and remained the seat of government until 1847, yielding then to Lansing.

THE LOST FIND THEMSELVES
An electronic push-button guide helps a Canadian sailor find his location.

DEUCALION, *du ka'le on.* According to the ancient Greek legends, Zeus, mightiest of the gods, once sent a deluge to destroy all life on earth because the people on it were so wicked. He spared, however, Deucalion (the son of Prometheus) and his wife Pyrrha, because of their goodness. Deucalion and Pyrrha drifted in a boat to Mount Parnassus, where they were given refuge. When the deluge was over, they descended and found themselves to be the only living people on earth. They went to the oracle at Delphi and were told to throw the bones of their mother behind them. They interpreted this message to mean *Mother Earth;* so they threw rocks over their shoulders. The stones were transformed into men and women when they struck the ground.

DEUTERONOMY, *du ter on'o me.* Last of the five *Books of the Law* contained in the Old Testament is *Deuteronomy.* In it,

Ewing Galloway

HERO OF IRISH FREEDOM

Eamon de Valera, a great Irish leader, was born in the United States.

written in beautiful language, are many of the laws which have been followed by Jews throughout the world for centuries. The Ten Commandments also are a part of *Deuteronomy*. The book closes with an account of the death of Moses.

DE VALERA, *val a'rah,* EAMON (1882-). Although he was born in New York City, Eamon de Valera became the Prime Minister of Eire (former Irish Free State). He inherited the leadership of the struggle for the freedom of Ireland.

Educated in Ireland, he joined a group opposed to British rule and took part in the rebellion of 1916, for which he was sentenced to death. Later the sentence was reduced to life imprisonment, and a year later he was released. Elected President of a proposed Irish Republic in 1917, he was again arrested. But he escaped to the United States in 1919, and returned to Ireland two years later.

De Valera's party, Fianna Fail, gained control of the Free State Parliament in 1932, and De Valera became President of the Executive Council. The Irish people approved a new Constitution in 1937, establishing the sovereign state of Eire. De Valera was its Prime Minister until his party lost the elections in 1948, but he served again from 1951 to 1954.

DEW. On a summer morning, after a cool, still night, tiny droplets of water are found on the grass and leaves of trees. This is dew, caused by the condensation of vapor on a cool surface. Some of the moisture comes from the ground and from the vegetation, as well as from the air.

The reason why dew occurs on still nights is that evaporation may almost cease in the cold night air, thus the leaves of plants and blades of grass become covered with moisture from transpiration which, under ordinary daytime conditions, would be evaporated. If grass covers the ground, the blades become colder than the ground below, since blades of grass cool more rapidly by radiation than does the ground. Thus when the warm, moist air rises from the surface of the earth, it strikes the comparatively colder leaves or blades of grass, and much of the moisture condenses.

Dew requires many conditions for its formation. It does not usually form on windy nights, since evaporation will take place all night and the radiation which cools the surface may be more than offset by the condensation from the moving air. It cannot readily form on cloudy nights, since clouds prevent much radiation from the ground. The ideal night for the formation of dew is a clear, still night after a bright, warm day.

The amount of dew varies in different localities. In the tropics, much dew is deposited owing to the nearly invariable occurrence of clear, quiet nights. Even in the northern part of the United States, the dew on some nights is equivalent to more than .01 inch of rain.

When the temperature of the leaves or grass falls below freezing, the previously formed dew freezes, and subsequent condensation is directly into ice crystals, forming what is known as *hoar frost*. See FROST.

United Press

MOPPING UP AFTER DEWEY'S VICTORY

American troops make a landing after Admiral Dewey's dramatic defeat of the Spanish fleet in Manila Bay. They marched on to take Manila.

DEWEY, George (1837-1917). Hero of the smashing victory of the American fleet over the Spaniards in the Battle of Manila, George Dewey was one of the few men ever to be named *admiral* of the United States Navy.

Born in Montpelier, Vt., George Dewey attended the United States Naval Academy at Annapolis, and upon his graduation was assigned to the frigate *Wabash*. When the Civil War broke out, he served under Farragut at New Orleans. Following the war, he was assigned to various ships and in 1896 attained the rank of commodore.

War between Spain and the United States began in April, 1898, and Dewey, familiar with the Pacific Ocean, was placed in command of the Asiatic Squadron. He received information that the Spanish fleet was somewhere in southern waters, probably near the Philippines, and there he steamed with his fleet. As he expected them to be, the Spanish ships were in the harbor of Manila. On May 1, 1898, Dewey opened fire, and at the end of the day had destroyed the enemy fleet, the Americans losing not a man nor a ship.

When the news of Dewey's triumph reached America, he was hailed as a hero. Created an admiral, he returned to the

United States to receive a hero's welcome. Men, women, and children contributed funds to purchase a house in Washington for him, and a law was passed permitting him to remain in active service for the remainder of his life. See SPANISH-AMERICAN WAR.

DEWEY, JOHN (1859-1952). The modern method of teaching by experiment and practice owes much to John Dewey, an outstanding leader in progressive education. A native of Vermont, he was educated at the University of Vermont and at Johns Hopkins University. After serving on the faculties of the universities of Minnesota, Michigan, and Chicago, he became, in 1904, head of the Department of Philosophy at Columbia University.

Professor Dewey has a wide reputation as a lecturer and writer, and is identified with advanced liberalism in the social and economic fields. He once delivered a series of lectures at the University of Peking, and he outlined a plan for reorganizing the schools in Turkey. He was an ardent supporter of the Hull House when it was established by Jane Addams in Chicago. Some of his writings include *Democracy and Education, How We Think,* and *Psychology,* as well as numerous articles which have appeared in periodicals.

DEWEY, THOMAS EDMUND (1902-). As a prosecutor of racketeers, Thomas E. Dewey won such national prominence that three times his name was presented as the Republican candidate for President. He lost the nomination to Wendell Willkie in 1940, but in 1944 was the Republican candidate opposing Franklin D. Roosevelt's campaign for a fourth term; although unsuccessful in the election, he received over 22,000,000 votes, or more than 85 per cent of the number polled by Roosevelt. The third time was in 1948, when he waged an unsuccessful campaign against Harry S. Truman, but polled over 90 per cent as many votes as the winning candidate.

Dewey was born in Owosso, Mich., graduated from the University of Michigan in 1923, and in 1925 received the LL.B. degree at Columbia University. The following year, he was admitted to the New York bar and began his law practice in New York City, where he early interested himself in politics as a Republican.

His growing reputation caused him to be appointed, in 1931, chief assistant to the United States District Attorney of the Southern District of New York. He became so expert in the technique of proceeding against big racketeers that in 1935 Governor Lehman appointed him special assistant to the United States District Attorney. In 1938, Dewey was himself elected District Attorney of New York County. Four years later, he became governor of New York, returning to that post in 1944. He was re-elected in 1946.

DEXTRIN, *dek'strin.* By the action of ferments, acids, or heat on starch, a gummy, white, odorless substance called *dextrin* is obtained.

During the digestion of food, starch is changed to *maltose* or *glucose,* and dextrin is one of the products formed during the change.

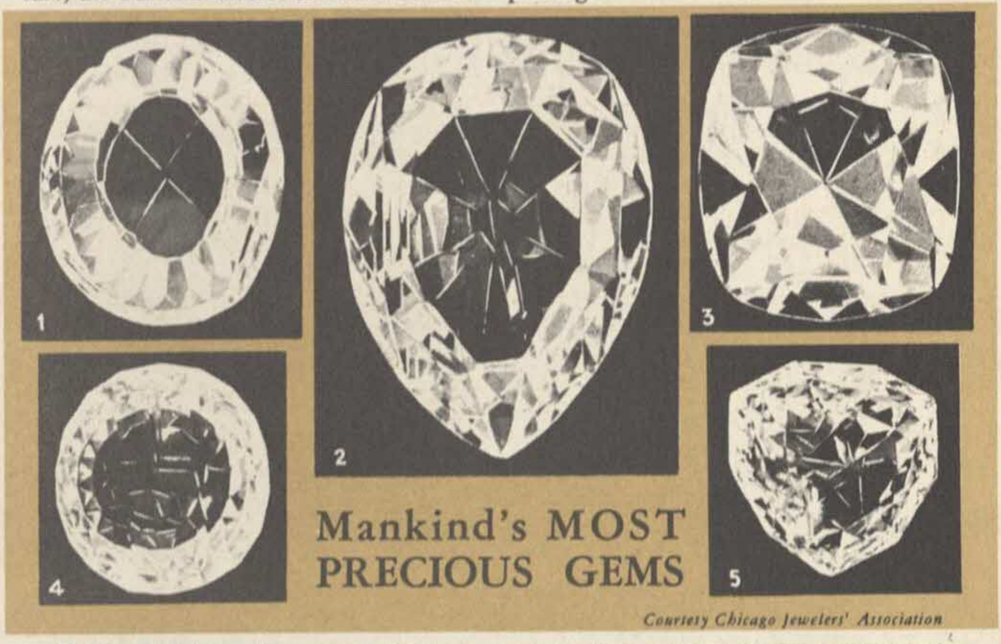
For commercial purposes, dextrin is prepared from potato starch or cornstarch by moistening with weak nitric acid, then drying and then heating to 110°C.; or by heating the starch to about 250°C.

Dextrin is used for stiffening different goods, being used instead of gum arabic. It is also used on the back of postage stamps. As a substitute for gum, it is found to be more flexible and less brittle when dry.

DI'ALECT. Dear to the heart of all English-speaking people are the poems of Robert Burns. Yet, they neither sound nor read like the English we are taught in our schools. Burns wrote in the Scottish dialect, the language spoken in his homeland, which differs in grammar, vocabulary, and pronunciation from the standard forms of English.

Every country has, within its borders, variations of its accepted native tongue. In America there are, among others, the Yankee, Hoosier, Negro, and French Creole, all of which differ in accent and vocabulary from conventional English. In most cases the recognized language of a country was originally a dialect which gained dominance over all the others. For example, as Paris grew to be the center of French culture, the Parisian dialect became standard.

Dialects are interesting to study for the information they give on the growth of language. However, with increased means of communication and frequent intermingling of people, they are rapidly disappearing.



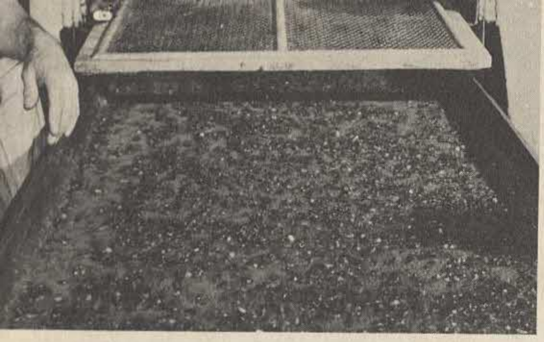
Courtesy Chicago Jewelers' Association

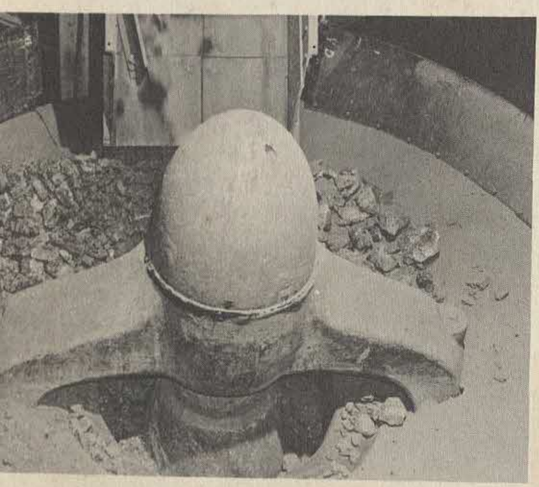
The fiery brilliance of the world's few huge diamonds reflects a tale of fantastic mystery and bloodshed. (1) King of diamonds—the Kohinoor. (2) Largest of diamonds—the Cullinan. (3) The 245-carat "Jubilee" diamond. (4) The romantic Orloff. (5) The Florentine.

DI'AMOND. The hardest substance known to man is the diamond, a gem composed of pure crystal carbon, brittle but possessing a brilliant luster. It is the same substance chemically as charcoal, coal, and graphite, but differs in being a clear crystal. It is usually colorless, but sometimes is found in pale shades of yellow, red, orange, green, blue, or brown; sometimes dull black. The black variety is called *carbon* or *carbonado* and is used as an abrasive and for diamond drilling. Diamonds are sold by weight—the unit being the *carat,* which is 200 milligrams. It would take 2,267.95 carats to equal one pound avoirdupois.

Some of the world's famous diamonds have most interesting stories. Books have been written about them and the many crimes that have been committed to gain their possession. Some, such as the blue Hope diamond (forty-four carats), are reputed to bring bitter fortune to the owners.

The largest diamond ever found is the Cullinan, which weighed 3,025 carats before cutting and was cut into nine stones, the largest weighing 516½ carats. The Victoria (or Imperial) weighed 457 carats before cutting, 180 carats afterward; the Stewart, 288 carats after cutting. The Kohinoor weighed 186 carats when brought to England, but was recut to 106 carats; the Orloff (stolen from the eye of an idol), 193 carats after cutting; the Regent, or Pitt, 137 carats.

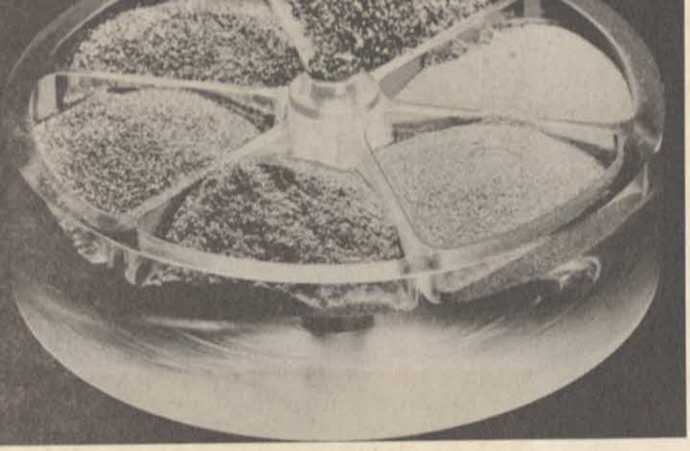


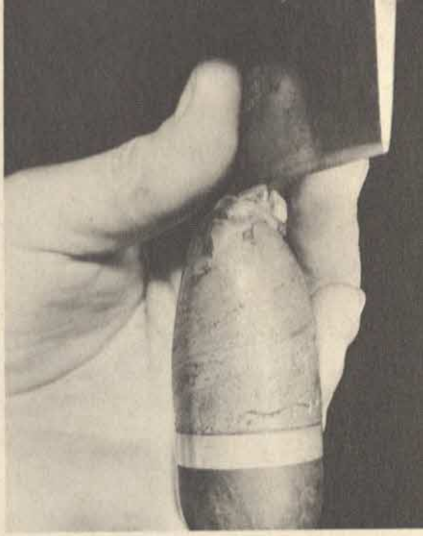


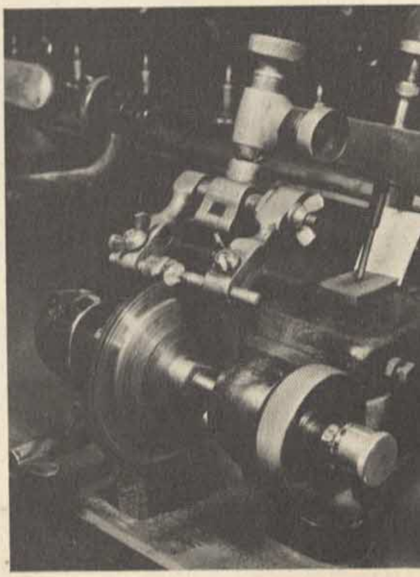
N. W. Ayer & Son, Inc.

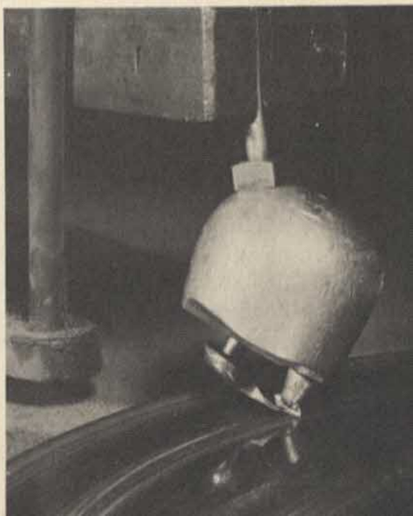
THE SEARCH FOR BEAUTY

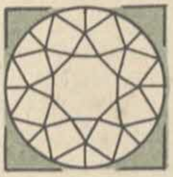
Hundreds of feet below the earth's surface, miners in South Africa drill holes for dynamite to blast the "blue ground" that yields diamonds. The rubble from the blasting is first passed to a crusher and then flushed over long, grease-covered tables. Most of the material floats away but left behind in the grease are the valuable diamonds for gems and industrial use. The precious stones are finally sorted into parcels for valuation by experts.











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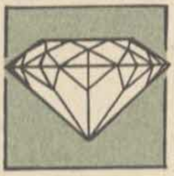

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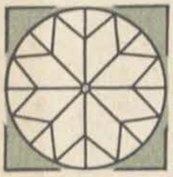

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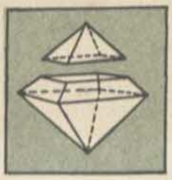

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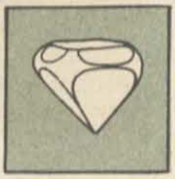

ROUGHED

A BRILLIANT PERFORMANCE

A dish only three and a half inches across holds 100 carats of man-made industrial diamonds. These are valuable, but have only a fraction of the value of gem diamonds, which require careful cutting to sparkle their best. A stone to be cleaved is set in shellac on a holder and properly notched. Then a light tap of a mallet splits it along natural cleavage planes. Today, most diamonds are sawed, not cleaved, by a thin spinning saw blade impregnated with diamond dust. The divided stone is then "roughed" by holding it against another revolving diamond to round off the corners. After roughing, the stone is set in another holder and held against a turning iron disk, also coated with diamond dust, for polishing. Most diamonds are polished in the brilliant shape with 58 facets to catch the light. Each facet is accurately placed according to a fixed pattern and the stone must be reset in the holder for each facet. The diamond cutter examines it hundreds of times with a magnifying glass to be sure the right amount is cut away.

N. W. Ayer & Son, Inc. *UPI*

Cutting. Diamonds were cut in various forms in ancient times, some being merely rounded. In modern cutting, the form in which the stones are cut is designed to give the greatest possible brilliance. Facets are cut at such angles that most of the light entering the top of the gem is reflected in the lower part and again returned through the top. This form is called the *brilliant*. The brilliant may be compared to two truncated pyramids set base to base. This base is known as the *girdle*. The upper pyramid is the *pavilion* and the small, flat lower plane the *culet*. In a perfectly cut stone, the facets meet at points where three or more come together. In poorly cut stones these are tiny short edges instead of points.

The only substance that can be used in cutting diamonds is diamond dust. This is secured by crushing splinters and imperfect stones, and from dust worn away in the cutting. Cutting is chiefly done in Holland and Belgium, but increasingly in England and the United States.

Occurrence. Diamonds were found chiefly in deposits of sand, gravel, or clay until the discovery of the South African mines. There they are found in a very unusual volcanic rock called *kimberlite*. While a few diamonds are occasionally found elsewhere, the world's real source of supply is South Africa. In Arkansas, kimberlite rock is found in a few places. Companies have been organized to develop it and mine the diamonds. While about 5,000 (mostly small) diamonds have been found, no steady production has been maintained.

Before the discovery of the South African mines, India was, from the earliest times, the chief source of diamonds. The Indian yield is now very small. Brazil produces the black diamond, or carbon, and a few gems. Diamonds have been found in the United States in Arkansas, North Carolina, Virginia, Georgia, Wisconsin, California, Idaho and Oregon, but have been mined only in Arkansas. Microscopic diamonds are found in British Columbia, Ontario, and Quebec.

Value. The world's output of diamonds and the prices are controlled by an agreement between the South African producers. The United States imports an average of about $25,000,000 worth of diamonds each year.

Uses. Aside from their great use in jewelry, diamonds are used industrially for cutting, grinding, polishing, and engraving; for bearings and pivots; and for dies, wire drawing, and phonograph needles.

DIAN'A, or AR'TEMIS. Accompanied by stags, and carrying a strong bow in her hands, Diana roamed through the forests as goddess of the chase, according to ancient legend. The Romans called the goddess Diana; the Greeks, Artemis. She was the twin sister of Apollo, and the daughter of Jupiter and Latona. All who worshiped her were pledged to chastity.

DIAPHRAGM, *di'a fram*. The most important muscle used in breathing is the diaphragm. It is a broad, dome-shaped structure, attached to the lowest ribs at the sides, to the breastbone in front, and to the spinal column behind. It forms the floor of the chest, completely separating this cavity from the abdomen below. At rest, the diaphragm looks much like a bowl turned upside down, the upward-curving side being toward the chest and the hollow side toward the abdomen.

Strong muscular fibers stretch from the center of the dome downward and outward on all sides, giving the diaphragm power to move up and down. When air is breathed in, or *inspired,* the muscular fibers are shortened and the center of the diaphragm flattens downward, enlarging the chest cavity up and down. At each inspiration, too, the abdominal muscles are stretched and the organs are pressed downward and outward by the flattening diaphragm. As the air is in turn breathed out, or *expired,* the muscular fibers of the diaphragm relax, the abdominal muscles contract, and the pressure of the organs pushes the diaphragm back to its former position.

The possession of the muscular partition completely separating the chest and

2292

abdominal cavities sets the mammals apart from the lower vertebrate animals.

DIAS, *de'ahs,* Bartholomew (?-1500). To Spain went the glory of discovering the New World, but it was Portugal, her great rival for sea power, that found the ocean route to the Orient. This feat was accomplished by a voyage of Bartholomew Dias, several years before Columbus sailed west.

Dias, a Portuguese, sailed southward down the west coast of Africa, past any place then known to Europeans. His crew, like that of Columbus, feared the tempests and complained that they would never see their families again. But Dias persevered, and finally rounded the tip of Africa (1487), which his king, John II, called the Cape of Good Hope. Finally, after sailing a short way up the eastern shore, Dias turned back at the demands of his sailors. But he had made known a sea route to the spices and riches of the East.

Little is known of Dias' life. He died in a violent storm in 1500, while on a voyage to Brazil.

DI'ATOM. Everywhere in the world, in salt and fresh water, and in warm and cold regions, are found the diatoms, tiny one-celled plants belonging to the algae. There are thousands of different species, and countless millions of individual plants. Diatoms have existed from a remote period in the earth's history. Their cell walls consist chiefly of a hard substance, silica, which endures forever. Therefore the fossils of diatoms have formed vast deposits in soil and on the ocean floor. It is believed by some scientists that the oil resources of California originated in accumulations of fossil diatoms.

The fossils are used to make fine abrasives, in the manufacture of tooth powders and sound-proofing and insulating material, and as an absorbent for nitroglycerine in the manufacture of dynamite. See Algae.

GODDESS OF THE HUNT—DIANA

DIAZ, *de'ahz,* Porfirio (1830-1915). Mexico's alternately stormy and peaceful history in the last half of the nineteenth and first decade of the twentieth centuries centered in a large measure around Porfirio Diaz.

Skilled as a general, and noted as a leader of men, Diaz first attracted notice, when he was still a youth, in the war with the United States. Later, he led a band of patriots against the representatives of Napoleon III who sought to establish an empire in Mexico, and, in 1877, became President of the country through a revolt which he led.

Four years later, he was succeeded by Gonzalez, but returned in 1884, holding the Presidency until 1911. In that year he

COLLEGE
BANIPUR.
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was overthrown by General Madero and forced to leave the country. He died four years later in Paris at the age of eighty-five. See MEXICO.

DICKCIS'SEL, *dik sis'el.* Like the whippoorwill, the dickcissel takes its name from its call. Not only is the song unusual, but the bird, a member of the finch family, has attractive markings. Its back is grayish brown and there are reddish patches on the wings. The breast is yellow and is marked with a black band in the form of a crescent. The dickcissel is about six inches in length. It is found in the grassy fields and prairies between the Allegheny and Rocky mountains and in Southern Ontario and Manitoba.

DICK'ENS, CHARLES (1812-1870). No English novelist has been read so widely as Charles Dickens, one of the outstanding authors of the nineteenth century. His characters, such as the poor but optimistic Mr. Micawber, of *David Copperfield;* the cruel Fagin, of *Oliver Twist;* and Scrooge, of *The Christmas Carol,* are known the world over.

Many of his writings were drawn from his own experiences, particularly *David Copperfield.* Like young David, he was sent to work in a warehouse when he was very young. His family, which seldom could make ends meet, had moved from Landport, on the island of Portsea, where he was born, to Chatham, and then to London. But Charles left the warehouse to serve as clerk in a law office, and, later, became a newspaper reporter.

It was during his period as a writer for the newspapers that he contributed humorous sketches under the name of "Boz." These were published as *Sketches by Boz,* and, later, he became recognized definitely as a writer of note with the publication of *Pickwick Papers* (1837). His books were usually published in serial form, a fact which accounts, probably, for their loose construction. However, there is so much humor and excellent description of characters that any failings in the plot are usually passed by.

In 1842 Dickens made a trip to America and told of his experiences in *American Notes.* Three years later, he went to Italy, and upon his return wrote *Pictures from Italy.* In 1850 Dickens became editor of a periodical called *Household Words.*

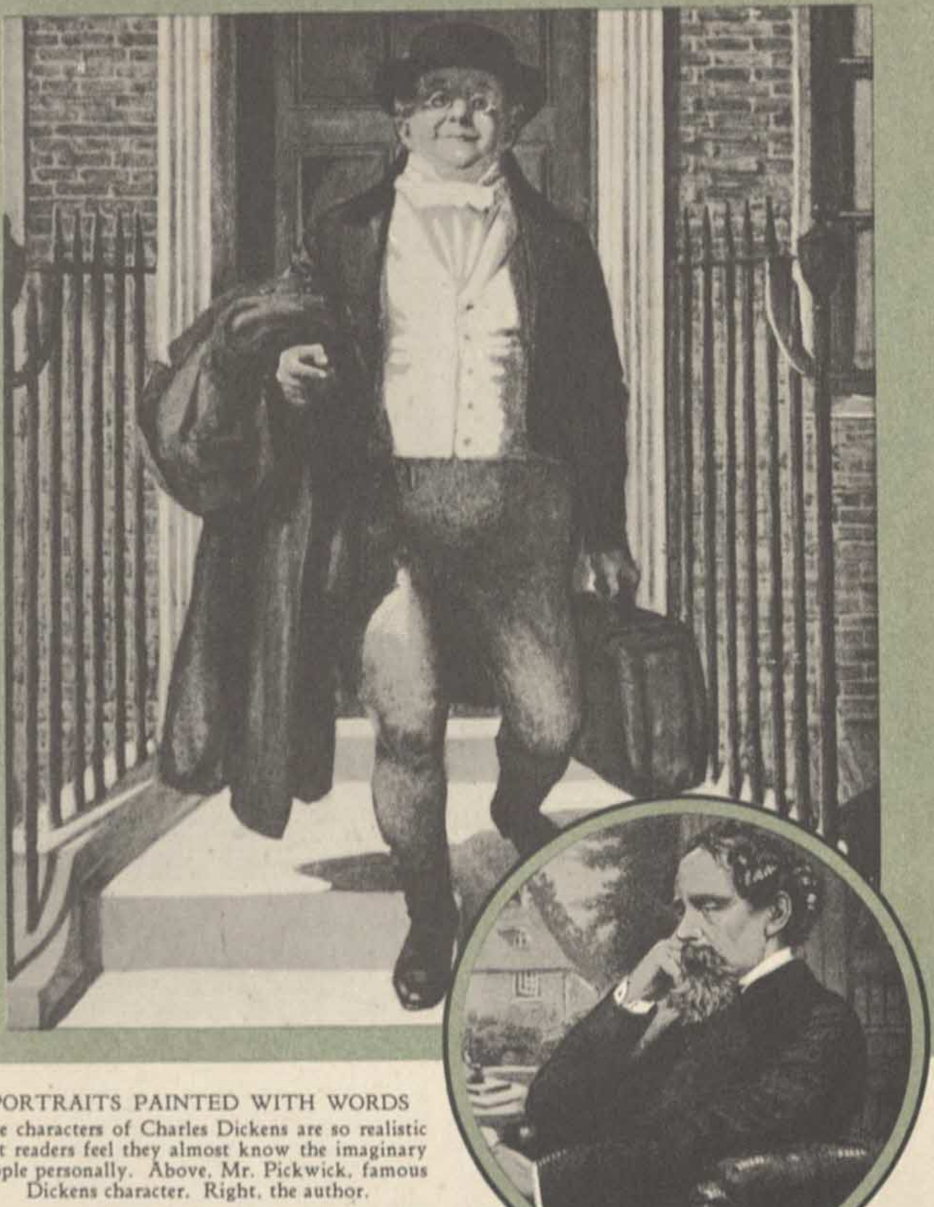
Some of his books, such as *Oliver Twist,* which describes the deplorable workhouse conditions of the time, and *Nicholas Nickleby,* exposing the management of cheap boarding schools, were influential in improving social conditions in England. Many persons consider *Great Expectations* his best novel, although Dickens himself liked *David Copperfield* the best of all his works.

Dickens was a pleasant conversationalist and a genial companion. He enjoyed the company of people, and was an enthusiastic theatergoer. He was a particularly observant person, and frequently amused his companions with delightful tales of the sights he had seen during the day.

Some of his other books include: *The Old Curiosity Shop, Barnaby Rudge, Martin Chuzzlewit, A Tale of Two Cities, Little Dorrit,* and *Our Mutual Friend.* He was working on another novel, *The Mystery of Edwin Drood,* when he died. He was buried in the Poets' Corner in Westminster Abbey.

DICTATOR, *dik ta'tor.* When more or less absolute power to rule a country is given to one man, we say that a dictatorship has been established. During periods of social and economic disorder, people are sometimes willing to give up the right of making their laws and are willing to take their chances with one man, following his ideas and plans. Very often the results may be worse, from a long-run point of view, than the original conditions. Among the dictators of modern times were Mussolini in Italy and Hitler in Germany.

The name harks back to the Roman dictator, a magistrate with wide powers who was appointed in times of danger to the state. The power was granted by the Roman Senate to one of the consuls. Although, unlike modern dictators, he had



PORTRAITS PAINTED WITH WORDS

The characters of Charles Dickens are so realistic that readers feel they almost know the imaginary people personally. Above, Mr. Pickwick, famous Dickens character. Right, the author.

no control over public funds, he did have authority over life and death without appeal. The state and other magistrates were virtually under his personal orders. Sulla and Caesar were dictators. See ROME, HISTORY OF.

DICTIONARY, *dik'shun ur e.* Every boy and girl should know how to use a dictionary. This book, containing the

TWO GREAT FIGURES MEET—AENEAS AT THE COURT OF DIDO

words of a language, arranged alphabetically with their pronunciation and meanings, adds to one's storehouse of expression and wealth of learning.

Do you know what part of speech a certain word is? If it is a verb, do you know whether it is transitive or intransitive? Do you know of any other words that have the same meaning? Do you know the origin of the word? If not, consult a dictionary. This information, and much more, are given in this book, including the modern definitions of a word, the principal parts of verbs, and examples of how words may be used.

Modern, unabridged dictionaries include a wealth of other information, such as well-known quotations and phrases, a pronouncing gazetteer of leading geographical places, brief biographical sketches of famous men, treatises on speech and language, and, sometimes, general historical and political data.

Dictionaries in an early form have been traced to the ancient Egyptians and Babylonians. But the first attempt to give a complete list of words in the English language was made by Nathan Bailey in 1730. Noah Webster is considered the father of the American dictionary.

Today, however, the name dictionary is used not only for lists of words, but for works on special or technical subjects, such as *A Dictionary of American Plays*.

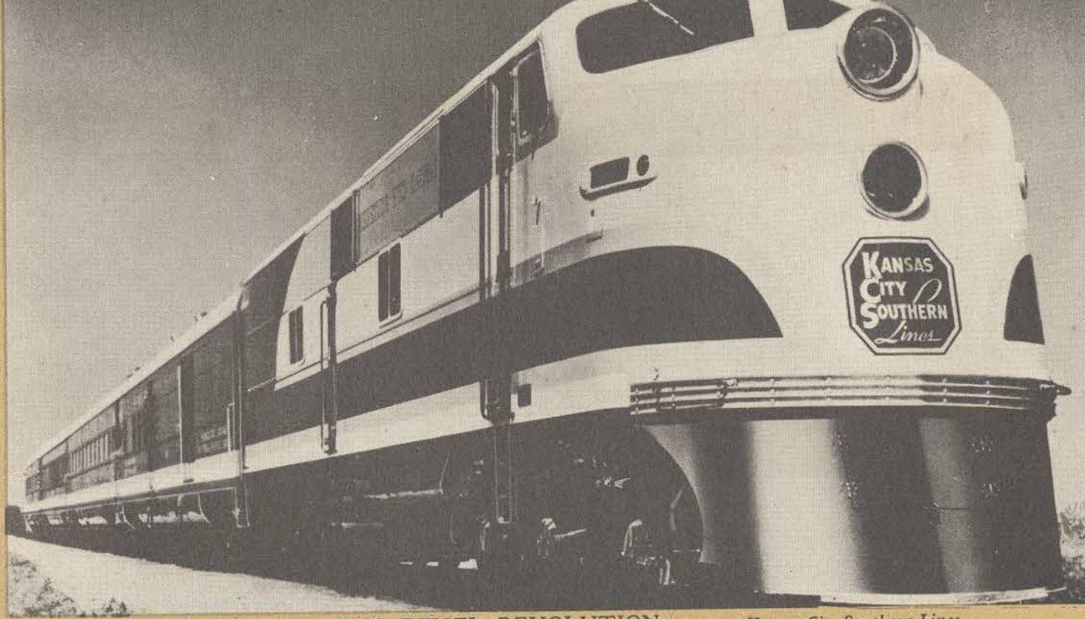
DICTOGRAPH, *dik'toh graf.* Everyone is familiar with the radio microphone over which singers and orchestras broadcast daily. The dictograph is merely a small sensitive microphone.

It is sometimes used by detectives in listening to the private conversations of people under investigation. Because of its small size, the dictograph may be hidden in a vase, behind a picture, or almost anywhere in a room. It picks up sound, even a whisper, and carries it by wire to a distant listener, amplifying it for better hearing.

Dictographs are often used, too, as a part of the hearing apparatus for partially deaf persons.

DI'DO. Roman legend held that Carthage, the ancient city in Northern Africa, was founded by Dido, princess of Tyre. After her brother, Pygmalion, became king of Tyre, he murdered her husband. She escaped with some wealth and a few fellow citizens to Africa. There she obtained from the inhabitants a promise of as much land as the hide of a bull would cover. Dido outwitted the natives by cutting the hide into narrow strips, which she made into a long rope. Then she took all the land she could encircle with it. On the land she built the magnificent citadel which later threatened Rome's supremacy.

According to the Roman poet Vergil, Aeneas, son of the king of Troy, escaped



THE DIESEL REVOLUTION *Kansas City Southern Lines*

Powerful, efficient diesel-electric locomotives now do most of the work on the railroads, replacing the romantic steam-powered "iron horse."

when that city was captured by the Greeks and traveled to Carthage, where Dido entertained him (see AENEID). When he departed, she killed herself for love of him. However, some historians believe that the queen lived prior to Aeneas and that she killed herself rather than marry the king of a neighboring country.

DIE. The tremendous mass production of modern automobile and similar industrial plants is made possible largely through the use of dies. These tools, which may be operated by hand or machine, are used in metal stamping, forming, and cutting operations where speed, accuracy, and economy are essential.

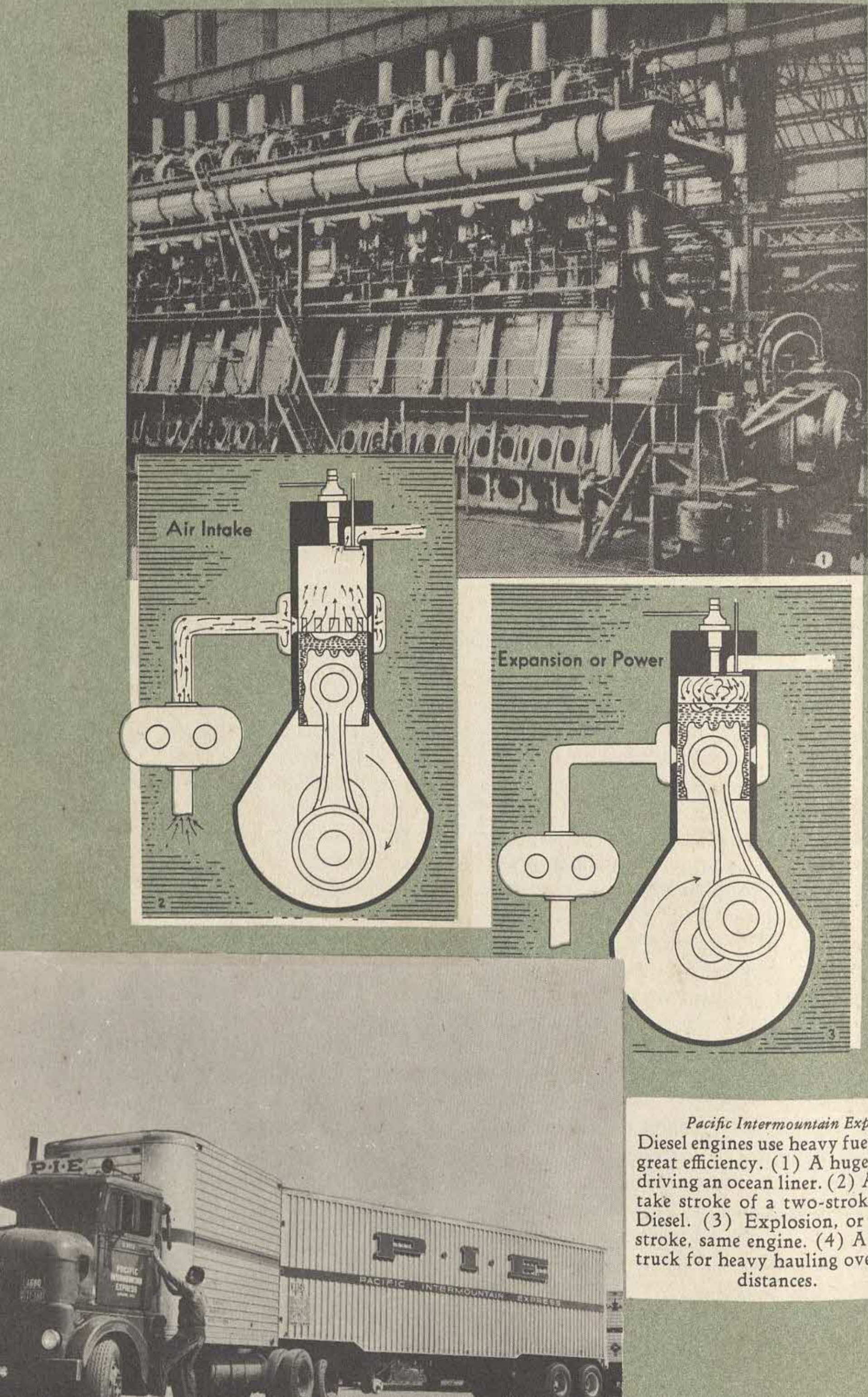
Cutting dies are used chiefly for threading pipes or rods; punching or forming dies for shaping sheet metal, steel bar stock, and even leather. Cutting dies usually have but one part; punching or forming dies consist of two or more parts which are squeezed together by lever pressure to give the desired contour to a part.

A good example of die work is in the making of automobile parts and bodies. Whole sections of an automobile body are stamped out and later welded into one solid unit.

Dies not only save time, but turn out greater quantities of like units than could be manufactured. Since die-formed work is close in contour to the design dimensions of the finished piece, it requires a minimum of machining. It saves freight charges on excess, dead metal when parts must be shipped unfinished, and saves part of the cost of raw material.

Small, hand-engraved intaglio dies are used in stamping coins, embossing paper, affixing seals, etc.

DIESEL, *de'zel,* **ENGINE.** Many of the streamlined trains that streak along the country's rails so swiftly are powered by Diesel engines. This type of internal-combustion engine was invented in 1892 by a German engineer, Rudolph Diesel, who made a fortune from it, but it was many years before refinements in design made it suitable for locomotives and lighter vehicles. The first applications of the Diesel were made in power plants, pumping stations, ships, and similar stationary installations. Engineering research has employed improved alloys and increasing knowledge of internal-combustion engines to make modern Diesels lighter and more efficient.



Pacific Intermountain Express Co.
Diesel engines use heavy fuels with great efficiency. (1) A huge Diesel driving an ocean liner. (2) Air-intake stroke of a two-stroke-cycle Diesel. (3) Explosion, or power stroke, same engine. (4) A Diesel truck for heavy hauling over long distances.

How Diesel Engines Operate. Although many Diesel engines operate on a four-stroke cycle principle like the ordinary gasoline engine, they are heavier, have no spark plugs, and use high compression and an injection system to burn heavy fuel oil instead of gasoline. By compressing air in the cylinders of the engine to a pressure of 500 to 600 pounds per square inch, a temperature of about 1000°F. is produced. Into this heat, fuel oil is sprayed at tremendous pressure by unit injectors. The fuel starts to burn immediately, the hot gases expand, forcing the pistons downward, and the energy of the fuel is converted into power. Diesels with two-stroke cycles also are made; size for size, they give twice the power of the engine with a four-stroke cycle.

Diesel engines have the advantage of being relatively inexpensive to operate because they use fuel with greater efficiency than do gasoline engines. They convert several times as much of the energy in a fuel into work as does the steam engine or steam turbine. Diesels are performing successfully in boats, automobiles, tractors, and even airplanes. See Gas Engine.

DIE-SINKING. Before buttons, coins, medals, or jewelry can be manufactured, dies must be made for cutting them out and stamping them with a design. The art of preparing these dies is known as die-sinking (see Die).

Specially selected steel is first forged into the rough shape of the die, then softened by annealing and given to the engraver for cutting. With special cutting tools, he engraves the design into the metal, after which the steel is hardened, cleaned, and polished. This original die is known as a *matrix*.

From this matrix, a *punch* is made by forcing softened or annealed steel against it until the impression is transferred to the punch. The design on the punch, however, will be in relief, or raised above the surface. The punch is then hardened and polished just as was the matrix.

The punch is then used as a pattern, and any number of dies can be made by forcing soft steel against its face. These, of course, are afterward hardened. To speed up the process, the design is often engraved on rollers and transferred to sheet metal by applying great pressure.

DI'ET. Various assemblages and legislative bodies in the United States are called by different names — congresses, conferences, assemblies. In many European countries they are called diets. History records a number of diets, particularly those held to settle religious controversies; a famous example is the Diet of Worms, before which Martin Luther appeared in 1521. The parliaments of the old German and Hungarian states were known as diets.

for RADIANT HEALTH
Balanced Nourishment

DIET. This term means what is eaten and drunk habitually; our daily food is our diet. A proper diet consists of food well selected to suit the needs of health, growth, and activity. A prescribed course of feeding may be spoken of as the diet of a person or group of people. A prescribed diet should apply the laws of nutrition in the feeding of particular individuals; such factors as age, size, weight, and activity should

Courtesy National Dairy Council

EVERYBODY NEEDS Dairy products; milk, butter, and cheese. The diets of growing children should include at least a quart of milk a day, because it contains the substances needed for growth. Butter and other natural fats (below) are energy foods, as are the sugars and foods classed as sweets. Weekly amounts should be about a pound of fat, and half a pound of sugar.

enter into the choosing of the kind and amount of food in a diet.

Chemists have made careful analyses of most of our foodstuffs, and have found them to be composed of *carbohydrates* (starch, sugar, cellulose, and others), *proteins, fats, mineral elements* (as calcium or lime, phosphorus, iron, etc.), and *water* in varying combinations and proportions. By other methods we know that in foods, vitamins are variously distributed.

Physiologists tell us these substances are the things necessary to make children grow, and that they are needed for men and women also, to keep them strong and healthy, able to work and play. Food must (1) provide energy needed for work and for keeping the body warm; (2) it must provide material to build new tissues as in growing, and to repair tissues as occasion requires.

Digestion of Food. Before food can be used by the body, it must be finely divided, put in solution, and chemically changed as it passes through the mouth, stomach, and intestines. No matter how carefully the diet may be planned, it may fail to nourish adequately if digestion is not carried on well. Bad teeth may be responsible for poor digestion, causing food to be swallowed without being chewed well, or without being moistened with saliva. Chewing pleasant-tasting food increases the flow of digestive juices of the stomach. "Bolting" one's food adds to the work of the stomach and lengthens the time the food has to remain in the stomach.

EVERYBODY NEEDS Cereal grains. These include bread of any kind, crackers, and breakfast foods. At least half of these should be in the form of whole-grain products, such as bran and whole-wheat bread. Truly the staff of life, bread must not be left out. These foods are the body's chief sources of the essential heavy starches, and they also contain proteins.

EVERYBODY NEEDS

Fruits and vegetables, sources of important vitamins. The diet should include at least two leafy green vegetables every day, besides potatoes. Some, like lettuce, should be eaten raw. Besides vitamins, fruits and vegetables contain valuable minerals, as well as cellulose. Below, spinach, cod-liver oil, milk, eggs, etc.

Courtesy National Dairy Council

Pleasant anticipation of food, and the sight, odor, and taste of good food, tend to speed up the flow of the digestive juices; worry, anger, fear, and discontent retard the flow and otherwise hinder digestion. Losing one's temper just before or at meal time, worrying over examinations, or any other mental disturbance may, therefore, cause "indigestion."

Selection of Food. Knowing the body's need in foods, it remains for us to select foods that meet these needs. Eating should mean something more than just satisfying the appetite. How well our diet serves us is an indication of the intelligence we use in selecting it. The appetite cannot always be a guide. Often appetite has been pampered and spoiled until it cannot be trusted to protect us against errors. Farm livestock have been studied and fed carefully to produce better products, but children are frequently allowed to eat anything they please. Bad dispositions, low resistance and vitality, poor complexions, and even disease, result from improper diets.

The best time to form good diet habits is when we are young, before our habits become too firmly fixed. A boy who satisfies his appetite on bread, meat, and coffee will become undernourished and underweight. He may change his dietary habits by reducing the meat and coffee and substituting vegetables and milk and become, thereby, a strong, healthy, finely developed boy. Food, then, must be chosen wisely to supply growing material, to provide energy for work, and furnish the materials which

EVERYBODY NEEDS

Meats or meat substitutes, to furnish protein. One or more of these should be eaten every day: lean meat, fish, eggs, nuts, beans. Those amazing chemical substances, the proteins, are contained in all living things. They are essential to tissue building and provide energy as well. They keep children growing, keep adults in health.

KEY TO CHART + + + Excellent Source + + Fair Source + Weak Source tr Trace

Name of Food	Vitamins			
	A	B	C	D
Vegetables				
Asparagus	++	+++	......	......
Beans, Kidney (canned)	+	+++	......	......
Beans, Navy (cooked)	+	+++	......	......
Beans (lima)	+	+++	+	......
Beans, String (cooked)	++	++	......	......
Beans, Soy (cooked)	+	+++	......	......
Beets (root)	+	+	+	......
Brussels Sprouts	++	+++	+	......
Cabbage (raw)	++	+++	+++	......
Cabbage (cooked)	+	++	+	......
Carrots (fresh raw)	+++	++	++	......
Carrots (cooked)	++	++	+	......
Cauliflower	+	++	+	......
Celery	+	++	......	......
Chard	++	+	......	......
Corn (fresh—yellow)	++	++	+	......
Cucumber	+	+	++	......
Dandelion Greens (cooked)	++	++	+	......
Lettuce	++	++	+++	......
Onions (raw)	+	++	++	......
Parsnips	+	++	......	......
Peas (cooked)	++	++	++	......
Potatoes, Sweet (cooked)	++	++	+	......
Potatoes, White (baked)	+	++	+	......
Radishes	......	++	++	......
Rhubarb (cooked)	......	......	+	......
Rutabagas	+	++	++	......
Spinach (cooked)	+++	+++	+	......
Squash (cooked)	++	......	......	......
Turnip (cooked)	+	++	......	......
Turnip Greens (cooked)	+++	++	+	......
Meats—Fish				
Fish (average)	+	+	......	tr
Kidney (beef)	++	++	+	......
Liver (beef-pig)	++	++	++	......
Meat (average)	+	++	+	......
Oysters (raw)	++	++	+	tr
Sweetbreads	+	+	......	......

Name of Food	Vitamins			
	A	B	C	D
Fruits				
Almonds	+	++	......	......
Apples (raw)	+	+	+	......
Bananas (raw)	++	++	++	......
Cantaloupe	++	++	......	......
Cranberries (cooked 3 min. unstirred)	......	......	+++	......
Grapefruit	+	++	+++	......
Grapes	+	++	+	......
Lemon Juice (fresh)	+	++	+++	......
Orange Juice (fresh)	++	++	+++	......
Pears	+	+	+	......
Pineapple (fresh or canned)	++	++	++	......
Prunes (dried)	+++	++	......	......
Raisins	......	+	......	......
Raspberries (fresh)	......	......	++	......
Tomatoes	++	+++	+++	......
Dairy Products				
Butter	+++	......	......	+ V
Buttermilk	+	++	+	......
Full Cream Cheese	++	+	......	+
Eggs (yolk)	+++	++	......	++ V
Milk (whole)	+++	++	+	+ V
Grain Products				
Barley (pearled)	+	++	......	......
Oatmeal (cooked)	+	++	......	......
Rice, Whole (cooked)	......	++	......	......
Rye Bread	+	++	......	......
Wheat, Whole	+	+++	......	......
Fats and Oils				
Lard or Olive Oil	+	......	......	......
Margarine, Oleo	+	......	......	......
Cod Liver Oil, and other fish oils.	+++	......	......	+++

This composite chart is compiled from the most authoritative sources available

Courtesy Creamery Package Mfg. Co.

VITAMINS MEAN HEALTH. NATURE PROVIDES THEM IN THESE FOODS.

stimulate and regulate the work of our bodies. What constitutes a well-chosen diet?

An adequate diet must furnish (1) sufficient energy-giving material; (2) the proper kind and amount of protein for building and repair; (3) the proper kinds and amounts of minerals as regulators of body activity and for building body tissues; (4) vitamins in sufficient amounts for the best health, as well as protection against certain diseases; and (5) water.

In order that one may be sure of getting all the materials needed by the body for growth, repair, regulation, and a supply of energy, the diet should contain, in suitable amounts, representatives of these groups; milk, meat, or its equivalent (fish, eggs, peas, beans, cheese), cereals, vegetables, fruits, sweets, fats.

Consult the following titles for additional information:

Absorption
Calorie
Cooking
Digestion
Food
Home Economics
Nutrition
Vitamin

DIFFUSION, *dif u'zhun.* If we take leaves from a tree at nightfall, treat them first with alcohol to remove the chlorophyll (green coloring matter) and then with iodine, they will turn blue-black from the effect of the iodine on the starch they contain. If we take other leaves from the same tree early the next morning, the iodine will make a less striking change in color, showing that the leaves now have less starch. What has happened during the night to cause this difference?

The answer is that there is constantly going on in the tree a process known as *diffusion,* by means of which starch and other foods manufactured in the leaves during the hours of sunlight are transferred to other parts of the plant. During the day the leaves produce these foods faster than diffusion can transport them, but during the night, diffusion gets the upper hand.

To understand diffusion, we must first realize that gases, liquids, and solids are alike made up of molecules of energy, and that these molecules have always a tendency to separate and mix with the molecules of the substance with which they are in contact. Water, for instance, evaporates because the molecules on its surface fly off and mingle with the molecules of air.

The reason for the tendency of molecules to separate, and to diffuse into other molecular substances, seems to be that they are in constant motion. That is, a piece of iron, or anything else we consider solid, is in reality composed of countless particles so energetic that, if their energy could be put to use, it is said that a piece of chalk the size of a chestnut would yield enough power to drive the largest steamer across the Atlantic.

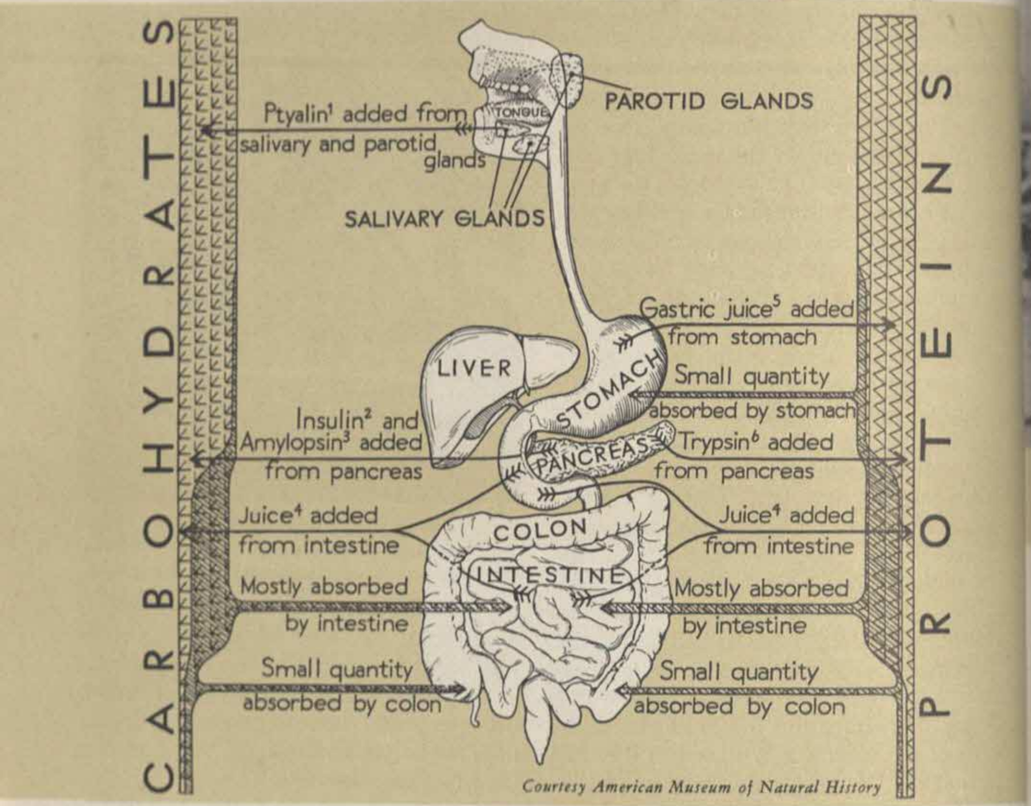
In the lower orders of plant life, all diffusion takes place through the walls of the plant cells. That is, the diffusing substance first mingles with that of the cell wall, then those molecules which entirely penetrate the wall pass on into the next cell. This type of diffusion is known as *osmosis.* In higher plants there is both osmosis and diffusion through special conductive systems.

THE BODY AS A "FACTORY"
Food entering the digestive "factory" gets its first treatment toward assimilation in the mouth.

DIGESTION, *di jes'chun.* The process of changing the food we eat into a form which can be carried by the blood stream to the body cells is known as digestion. It begins when food enters the mouth and ends with the removal of waste matter from the large intestine.

Food, upon entering the mouth, is chewed into small bits by the teeth and mixed with a fluid, the *saliva.* This alkaline juice acts upon starchy foods, turning some of the insoluble starch into soluble sugar. As the chewing progresses, the soft mass is worked by the tongue toward the back of the mouth, where it is seized by the muscles of the esophagus and conveyed to the stomach.

Upon entering the stomach, food is somewhat alkaline. This condition automatically releases the *gastric juice,* which is composed of the ferment *pepsin* and of *hydrochloric acid.* The alkalinity gradually changes to acidity, action ceases on the starches, and the dissolving of proteids begins. Moreover, milk is curdled and fat globules are dissolved. In the meantime, a constant churning has been applied to the food by the stomach muscles. This churning, mixing, and digesting process con-


CARBOHYDRATES
PROTEINS
PAROTID GLANDS
Ptyalin[1] added from salivary and parotid glands
TONGUE
SALIVARY GLANDS
Gastric juice[5] added from stomach
LIVER
STOMACH
Small quantity absorbed by stomach
Insulin[2] and Amylopsin[3] added from pancreas
PANCREAS
Trypsin[6] added from pancreas
Juice[4] added from intestine
COLON
Juice[4] added from intestine
INTESTINE
Mostly absorbed by intestine
Mostly absorbed by intestine
Small quantity absorbed by colon
Small quantity absorbed by colon

Courtesy American Museum of Natural History

NATURE'S MARVELOUS CHEMICAL PLANT—THE DIGESTIVE TRACT

Food must be "broken down" into simpler chemical forms before it can be absorbed. The carbohydrates, fats, and proteins cannot be assimilated in the forms in which they are eaten, and certain ferments of the digestive juices and bile act upon them. Water and mineral salts aid in the process.

tinues in the stomach for about four hours, changing the food to a thick, souplike substance called *chyme.* After about two hours, the first of the chyme begins to pass into the small intestine.

Upon entering the small intestine, the chyme is immediately acted upon by the *pancreatic juice, intestinal juice,* and *bile,* all alkaline fluids. The fact that the chyme is acid causes these juices to flow abundantly; the pancreatic and intestinal juices complete the digestive breakdown of foods, while the bile is concerned chiefly with alkalizing the mixture. By the time these fluids have completed their work, the food has reached a thin milklike consistency and is somewhat alkaline.

All the usable portions of the food are absorbed into the blood stream through the *villi,* located in the walls of the small intestine. Each villus is like a tiny glove finger and contains capillary blood vessels and lymphatics. The lymphatics in this region are called *lacteals* (the French for *milk*), because the food products they absorb, called *chyle,* look like milk. See ABSORPTION; FOOD; SALIVA.

DIKE. If one were to peer into the cone of an active volcano, he would see molten, igneous rock bubbling at a very high temperature. When this rock flows into a crevice in the earth and cools, it hardens, forming a dike. Dikes are found in all regions subject to volcanic action and vary

Chicago Natural History Museum

A CREATURE NO COWBOY WOULD DARE TO MOUNT

Some 150,000,000 years ago giant dinosaurs like this Stegosaurus roamed the earth. Despite its size and fearsome appearance, this reptile lived on vegetation rather than flesh.

in thickness from a few inches to hundreds of feet. They resemble veins containing ore deposits, but should not be confused with them.

The name is also applied to artificial banks built to prevent land from being flooded by near-by water. Holland lies below sea level and is protected from the North Sea by dikes. In many other parts of the world, too, dikes are constructed to reclaim river valleys.

DIME. A silver coin of the United States worth ten cents is called a dime. As a matter of fact, however, there is only about five cents' worth of silver in a dime. The word *dime* is of French and Latin origin and means *tenth;* a dime is the tenth part of a dollar.

DINGO, *ding'go.* A fierce, wild dog, the dingo is found in Australia. It looks very much like a wolf, having yellowish-brown hair, a bushy tail, and short, erect ears. Its natural cry sounds like the howl of a wolf. These dogs hunt in packs, attacking sheep and small domestic animals. However, dingo puppies have been tamed and have even learned to bark when kept with dogs.

DINOSAURIA, *din o saw' ri ah.* A class of reptiles inhabiting the earth millions of years ago is known as the *Dinosauria.* Varied in appearance, these beasts are classified as being between the lizards and the ostrich-like birds.

Some dinosaurians were no larger than pigeons; others were of huge proportions. Among the largest were those of the genus *Diplodocus.* Their bodies were about sixty-

AUSTRALIAN FARMERS' MENACE

The dingo, Australia's ferocious wild dog, preys upon sheep and other livestock all over the continent. Dingos roam in packs, and while individuals are cowardly, the herd is capable of terrible destruction.

ONCE A SAVAGE JUNGLE KING

Biggest of the dinosaurs, the Brontosaurus was larger than any animal now living. In spite of his enormous size, he was profoundly stupid.

five feet long, the reptiles weighed about thirty-five tons, and they fed on vegetation. Members of still another genus, the *Tyrannosaurus,* had thick, heavy tails, walked on their hind legs, and were flesh-eating animals, with teeth sometimes almost a foot long. Dinosaurians of the genus *Iguanodon* were about thirty feet long and four feet high. They were covered with scales and fed upon vegetable matter. All these animals had small heads, indicating small brains and a low grade of intelligence. See GEOLOGY.

DIOCLETIAN, *di o ķle′ shun* (245-313). The earliest example of bureaucracy in government was introduced by Diocletian, a Roman emperor from 284 to 305. A man of humble birth, he had been raised to power by the army. In 286 he appointed an associate emperor, Maximian, to rule with him, and gave two other subordinate officials (called Caesars) control of parts of the empire. With the government thus organized, the empire was strengthened. Diocletian and Maximian resigned in 305, and were succeeded by Constantius Chlorus and Galerius, the two Caesars.

DIOGENES, *di oj′ e neez* (about 412-323 B. C.). Usually the busy people of ancient Athens paid little attention to the bearded man who walked the streets barefooted and scantily clothed. The man was Diogenes the Cynic, whom people had learned to avoid because of his witty gibes at their follies. One day, however, public curiosity was aroused; for, although it was broad daylight, Diogenes carried a lighted lamp. In answer to questions, he replied, "I am searching for an honest man."

The cynical philosophy that Diogenes taught was easier to respect than to follow, for Diogenes believed that only by giving up all worldly possessions could happiness be gained. He himself, however, practiced what he preached. It was said that he slept in a tub, ate only the coarsest food, and had thrown away the one wooden bowl he possessed when he saw a boy drink from his cupped hands.

His fame was widespread. When Alexander the Great once offered to grant him a favor, Diogenes asked only that Alexander should not stand between him and the sunshine. And Alexander bowed to the philosopher, saying, "If I were not Alexander, I should wish to be Diogenes."

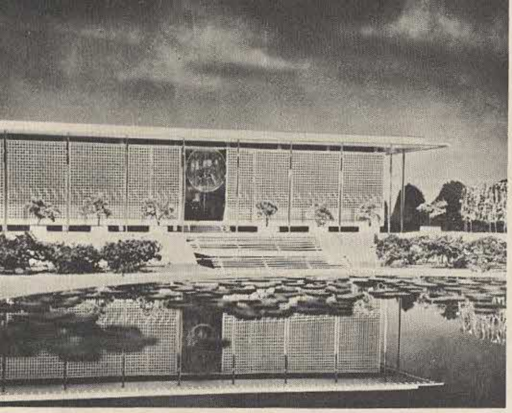
THE SEARCH THAT COULD NEVER END

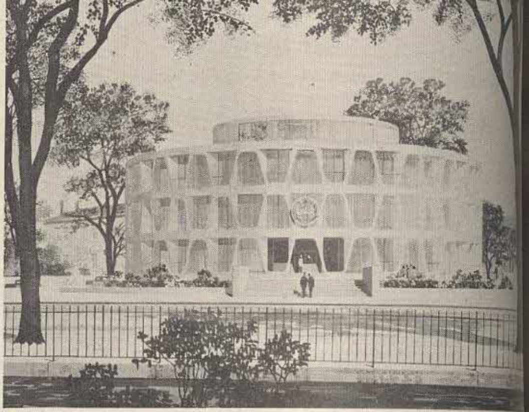
The Greek philosopher Diogenes, with his lantern, on the trail of an imaginary "honest man"

DIONYSIUS, *di o nish' i us,* THE ELDER (about 432-367 B. C.). When he was only twenty-five years old, Dionysius, who was very popular with the army of ancient Syracuse, seized the supreme power and became dictator of the city. He also gained control over other cities in Sicily. He was a cruel tyrant who was feared and even hated by the people; but he also did much to make Syracuse beautiful and famous. He encouraged art and learning and made the city a center of culture. After a reign of thirty-eight years, he was succeeded by his son, Dionysius the Younger.

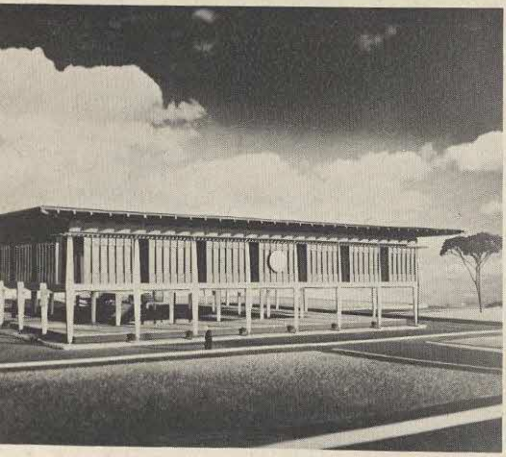
DIPLOMACY. The art or system of conducting negotiations between nations is diplomacy, and the special representatives who carry on these relations are called diplomats. Both words come from the Greek word *diploma,* a term used in ancient times to refer to a letter of license issued by a government.

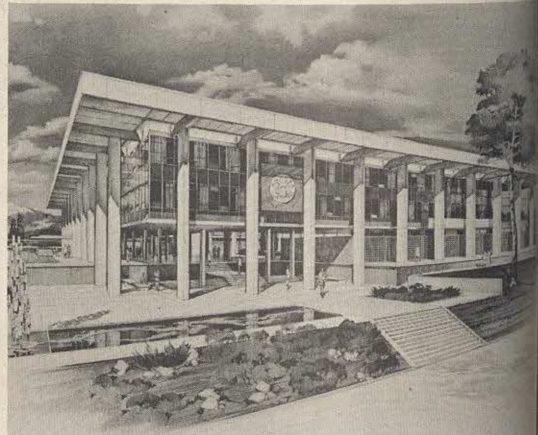
Ancient nations did not maintain diplomatic relations with each other, but appointed special embassies whenever occasion required. The modern system of resident ministers is said to have been originated by Cardinal Richelieu, in the seventeenth century. Today, because communications all over the world have become so rapid, some statesmen believe that diplomatic establishments are an unwarranted expense, and that their work could be accomplished through letters, cables, and

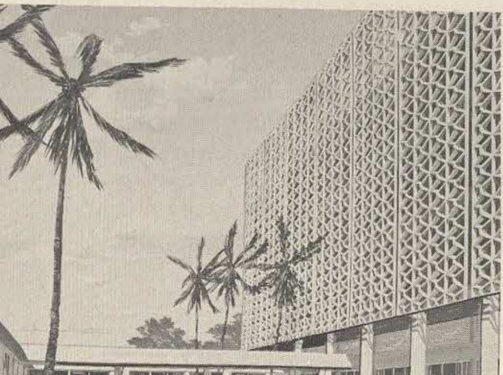




Diplomacy in Steel and Stone means designing embassies to suit local climate and customs. Stone grillework makes a lacy facade for the embassy building at New Delhi, India, upper left, and also filters out the hot Indian sun. The quiet waters of the pool add a further cool note. Far different in tone is the circular-styled embassy at Dublin, Ireland, upper right. It appears to grow firmly out of the ground with a rhythmic pattern of tiered arches. Stilts for airiness are needed at Ghana, Accra, lower left. Louvered windows let in every wisp of breeze, shut out intense heat. The classic simplicity of ancient Greek architecture is captured in the many-columned embassy at Athens, Greece, lower right.







Stone Lacework makes a frame of light and shadow for the embassy office building at Manila, The Republic of the Philippines, left. Around the world, the United States Government speaks through embassies such as these as well as through its representatives.

U.S. State Department

wireless service. But personal contact, often so effective, would then be absent.

The highest grade of diplomatic representative is that of ambassador; the next in order of rank are the envoy extraordinary and minister plenipotentiary, minister resident, chargé d'affaires, secretary of legation, and attaché. See AMBASSADOR.

A diplomatic representative is charged with all matters pertaining to relations of statecraft between his country and the one to which he is accredited. When relations are broken, as in time of war, diplomatic agents return to their own countries.

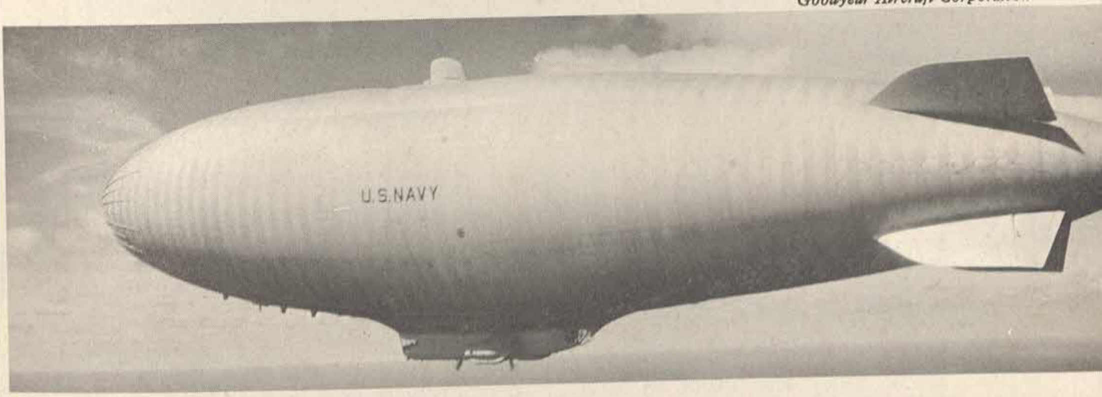
Formerly in the United States, there was a distinction between the consular service and the diplomatic service. Since 1924, however, both branches have been under the jurisdiction of the Foreign Service of the Department of State. The consuls represent the United States government at ports and commercial centers of foreign countries, where they promote foreign trade, issue passports and visas, and supervise various other matters.

DIP'PER, or WATER OUZEL, *oo'z'l.* This little "waterproofed" bird is found along streams in the mountain regions of the West from Alaska to Mexico. It is about the size of a fat sparrow, dark-colored above, rather lighter below, and often carries its tail erect like a wren. It runs about on the rocks and dives much into the water, even walking on the bottom in search of its food of water insects.

The dipper builds a nest of mosses and leaves in a rock crevice often behind a waterfall, and lays three to five white eggs. This curious little bird never fails to attract the attention of bird lovers.

DIRECTORY. See FRENCH REVOLUTION; NAPOLEON I.

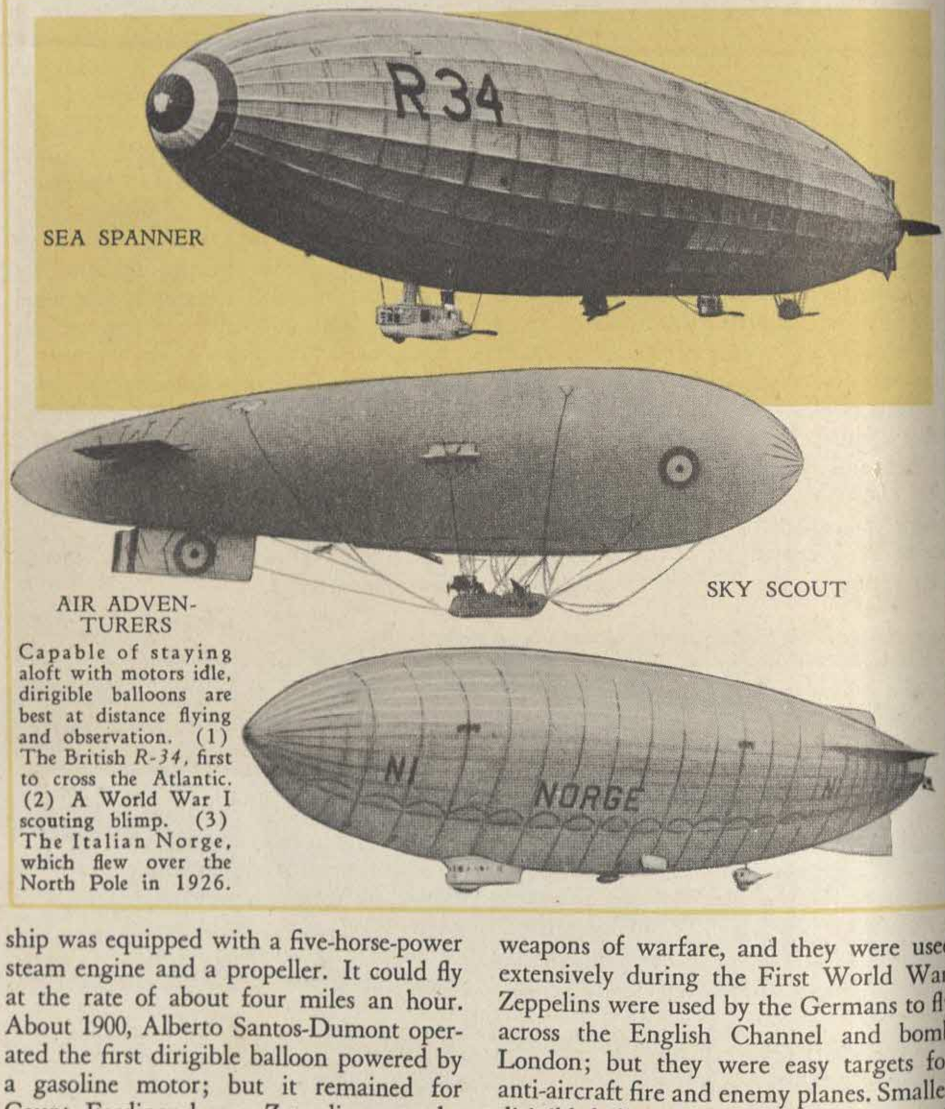
Goodyear Aircraft Corporation



MAMMOTH WATCHDOGS OF THE SKY MAINTAIN CONSTANT RADAR VIGIL
Dirigibles like this can stay on guard for days without refueling and weather the toughest storms.

DIRIGIBLE, *dir' i ji b'l,* **BALLOON,** a self-propelled, lighter-than-air craft that can be steered in flight. There are three types: *nonrigid,* in which a car with an engine is suspended from a bag filled with hydrogen or helium; *semi-rigid,* which has a free bag but a rigid keel; and *rigid,* constructed with a rigid framework of aluminum or duralumin and with a number of separate compartments for the gas. Dirigibles can lift more weight than airplanes; they can stay aloft longer without refueling; they can carry more powerful radar equipment; and the crews have more room while on duty. One dangerous drawback to dirigibles is that if they are filled with hydrogen, a spark may cause a disastrous explosion.

The first successful dirigible balloon was flown in 1852 by Henri Giffard, whose air-



SEA SPANNER

SKY SCOUT

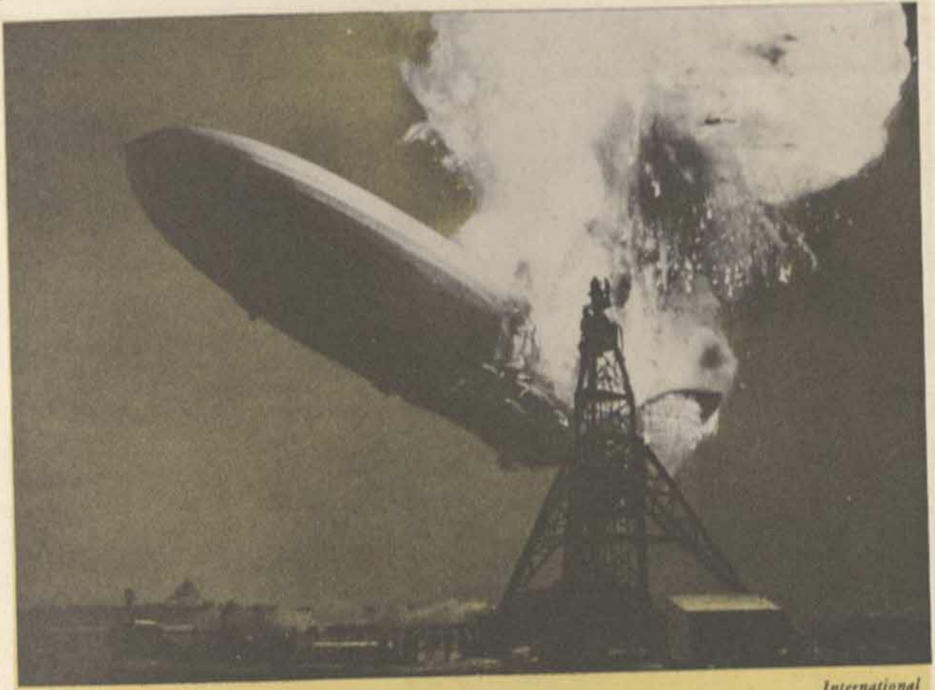
AIR ADVENTURERS

Capable of staying aloft with motors idle, dirigible balloons are best at distance flying and observation. (1) The British *R-34*, first to cross the Atlantic. (2) A World War I scouting blimp. (3) The Italian Norge, which flew over the North Pole in 1926.

ship was equipped with a five-horse-power steam engine and a propeller. It could fly at the rate of about four miles an hour. About 1900, Alberto Santos-Dumont operated the first dirigible balloon powered by a gasoline motor; but it remained for Count Ferdinand von Zeppelin to make the most important advancements in airship construction. He introduced the idea of a rigid framework for the dirigible balloon, perfected the design of the zeppelin, and laid the foundation for successful dirigible-balloon manufacture and operation.

Germany far outstripped other countries in the building of rigid aircraft, and about 1910 began to use the zeppelin type extensively for commercial purposes. Dirigible balloons, however, were long regarded as weapons of warfare, and they were used extensively during the First World War. Zeppelins were used by the Germans to fly across the English Channel and bomb London; but they were easy targets for anti-aircraft fire and enemy planes. Smaller dirigible balloons, particularly the "blimps," were of great value in scouting enemy movements and mapping territory. On the whole, World War I proved the inefficiency of the large rigid ships for active warfare. In later wars, their use was largely confined to the transportation of war materials.

Great achievements and great tragedies have marked the peacetime operation of rigid airships. In 1919, the English zeppelin *R-34* was the first dirigible to cross



International

DISASTER STRIKES A MONARCH OF THE SKIES

Thirty-six persons lost their lives in the explosion of the hydrogen-lifted passenger airship *Hindenburg*. Swept by vast waves of flame, the ship was completely destroyed in a few seconds.

the Atlantic Ocean. In 1929, the *Graf Zeppelin,* a German airship, flew around the world. The first regular transatlantic passenger service by air was established by German zeppelins in 1936. Disaster struck the following year. The *Hindenburg,* the greatest airship in the world at that time, was destroyed as it was attempting to land at Lakehurst, N.J., after a transatlantic trip. The highly inflammable hydrogen with which it was filled burst into flames from an unknown cause; within a few moments thirty-six persons were burned alive, and the 811-foot dirigible was only a mass of twisted girders. After this disaster, Germany abandoned transatlantic dirigible flights to the United States.

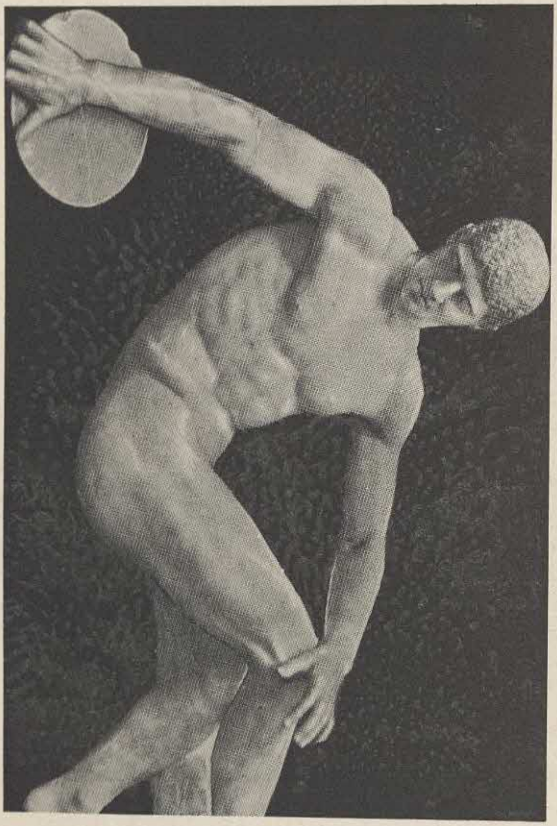
This country has also had unfortunate experiences with dirigibles. The first American rigid airship, the *Shenandoah,* crashed in 1925; the *Akron* was lost in a storm at sea in 1933; and two years later, the *Macon* was wrecked in the Pacific.

The United States Navy has been using the largest nonrigid airships ever built. These are used as aerial radar stations for early warning defense as part of the North American Air Defense Command. They carry the largest radar detection antenna ever taken aloft by an aircraft. The Navy also uses dirigibles for antisubmarine patrol duty. The United States is the sole source of helium, a noninflammable fuel, much safer to use than hydrogen.

For further information, consult the following titles:

Airplane
Balloon
Flying, Story of
Helium
Zeppelin, Ferdinand von

DISCIPLES OF CHRIST, or CHRISTIANS. In the early part of the nineteenth century, a Pennsylvania Presbyterian minister named Thomas Campbell, and his son Alexander, urged Christians to adopt a



TIME-HONORED SPORT
The discus throw of the ancient Greeks is a thrilling event in the modern Olympic Games. Left, a copy of a Greek statue. Above, modern discus thrower.

simpler faith. They held that the Bible should be used as the only source of laws and ritual in religion.

These teachings brought about a break with the established Protestant denominations. After a short affiliation with the Baptists, a new group called the Disciples of Christ, or the Christian Church, was formed. In the twentieth century the denomination split, one group forming the Disciples of Christ, and the other the strictly congregational Churches of Christ.

Both groups baptize by immersion and observe the Lord's Supper weekly. There are about 1,768,000 Disciples in the United States; some 903,000 members of the Churches of Christ.

DISCOUNT. This financial term applies to an allowance made for the payment of a debt before maturity; or a certain percentage reduction from an announced price; or an amount deducted from a loan of money as a payment to the lender, or any similar deduction from a sum of money. The first is ordinary *cash discount;* the second is known as *trade discount;* the third, as *bank discount.* In foreign exchange, discount is the opposite of *premium.* Thus, if a banker in the United States will give less than one American dollar for a Canadian dollar, Canadian money is said to be *at a discount;* if he will give more than an American dollar, Canadian money is *at a premium.*

Cash Discounts. When we buy lumber for a house, or any other material from a company that sells in large quantities, we are likely to find, on the bill for the goods, some such phrase as "2%-10 da." This means that if we will pay the bill within the number of days specified, the dealer will permit us to deduct a certain percentage of it. In other words, if a bill for $50 is marked "2%-10 da." we may deduct $1 (two per cent of fifty) and settle the bill by sending $49 within ten days of its date. It is always good policy to discount (that is, take the offered discount on bills), even if, to do so, it is necessary to borrow from the bank.

Trade Discounts. Allowances made by manufacturers to wholesalers and wholesalers to retailers are trade discounts and vary according to trade practices and the quantities of goods involved.

Bank Discounts. Amounts charged by banks for money they loan or advance on notes are bank discounts. When the banks in turn sell this collateral to a Federal Reserve Bank or larger correspondent bank, the transaction is called *re-discounting*.

DIS'CUS, THROWING THE. Requiring an excellent sense of timing and muscular coordination, throwing the discus is one of the most scientific of all track-and-field athletic events. It is also one of the oldest, for it was engaged in by ancient Greeks in their Olympic Games.

The modern discus is a circular missile made of wood, circled with iron, and containing lead in the center. Eight and five-eighths inches in diameter and nearly two inches thick at the center, it weighs about four and one-half pounds. The thrower must stand in a circle measuring eight feet two and one-half inches in diameter and may not leave it until he has completed his throw. He grasps the discus flat against his palm, using four fingers, and hurls it after a preliminary swing of his body. A skilled thrower can hurl the discus a distance of more than 160 feet.

Myron, an ancient Greek sculptor, carved in marble a fine figure of a discus thrower. Copies are common throughout the world. See OLYMPIC GAMES.

DISEASE, GERM THEORY OF. See GERM THEORY OF DISEASE.

DISEASES OF PLANTS. Every year plant diseases cause losses amounting to millions of dollars. The farmer, of course, is the biggest loser. But because diseases cut down the size of the various crops, higher prices naturally result; and this price increase must be borne by all consumers alike.

Nearly every plant disease is caused by one of the following agencies: *fungi, bacteria, insects,* or *physiological* causes. Fungi, the most common of plant afflictions, may live within the plant cells, fasten themselves to the roots, or pentrate the plant's epidermis (skin). Nearly all fungi throw spores into the air which may attack other plants. Rust, potato rot, mildew, and smuts of corn are typical examples.

Bacterial diseases are spread by insects that visit plants and leave disease germs. Once started, these diseases are incurable. The spread of the disease is prevented only by completely destroying the infected plants. Black rot of cabbage, fire blight of apples and pears, and tomato and sweet-corn disease are bacterial diseases.

Diseases caused by insects are much more prevalent in greenhouses than outdoors. The worst offender is the phylloxera, which is a mortal enemy of the grape. It attacks the roots of the plant, and whole vineyards in Europe have been laid waste by this pest. The eelworm, another insect pest, attacks oranges, cucumbers, peaches, and many other plants.

Physiological diseases are usually caused by poor soil, too much or too little water, or an improper amount of light. Such diseases usually turn the plant leaf a sickly yellow and give the plant an unhealthy appearance.

All these diseases may be kept under control by treating the seed to kill spores, burning stubble and shrubbery in the fields, spraying, and rotating crops. Planting clover and cutting weeds decrease rust, and special fertilization also tends to hold most of these plant afflictions in check.

DISHES. Although used primarily as containers for serving food at the table, dishes may also be used as temporary storing places for food and even as kitchen utensils in preparing baked foods.

Dishes, usually called tableware, may be either *earthenware* or *porcelain* (*china*). Earthenware, though cheap and heavy, may be made artistic and attractive. Porcelain is much lighter, translucent, and usually expensive. The finer sets of tableware are all of china.

The exact age at which dishes were first used is not certain, but crude dishes have been uncovered in burial mounds thousands of years old. Smaller dishes were merely balls of clay scooped out in the middle and fired in the open; larger dishes were made by building up the walls of the small bowls. The potter's wheel, a device for aiding the potter in molding a perfect product, was used in ancient Egypt thousands of years ago.

Early American colonists used dishes of wood, pewter, silver, and leather. An important dish of that day was the *trencher,* a block of wood hollowed out to form a sort of bowl. Two people usually ate together from a trencher. Drinking cups of wood, called *noggins,* and wooden *tankards* for carrying water were other important colonial dishes.

Pewter dishes were of a dull metal, which tarnished quickly and had to be scoured often. Leather pitchers, bottles, and drinking cups were common, but in the better homes these pieces were sometimes of silver. Chinaware was brought from England by a few of the early settlers and was later imported from China and the East Indies. Today, much beautiful "china" is made in America.

The Manufacture of Dishes. Using a special clay and other ingredients, the potter first molds the dishes and plates. This is done by forming one side of the dish with a mold, the other with a machine called a *jigger*. After shaping, the dishes are known as *green ware* and are baked in boxes of fire clay at temperatures as high as 2,000°, depending upon what sort of pottery is being made. The ovens, known as *kilns,* are usually long tunnels, through which the pottery passes on moving cars, baking as it goes.

The dish is then glazed to give it a shiny appearance, decorated, and rebaked. Sometimes the decorations are put on first, and covered with the glaze. Decorating is done by stamps, transfers, or by hand with a brush.

Modern Tableware. Many of the dishes today are of glass, plain or tinted. Silver and aluminum tableware are also used in many homes to a limited extent. Baking dishes of earthenware or glass have been perfected, which may be placed on the table as serving dishes, thus performing double duty. See POTTERY; CLAY.

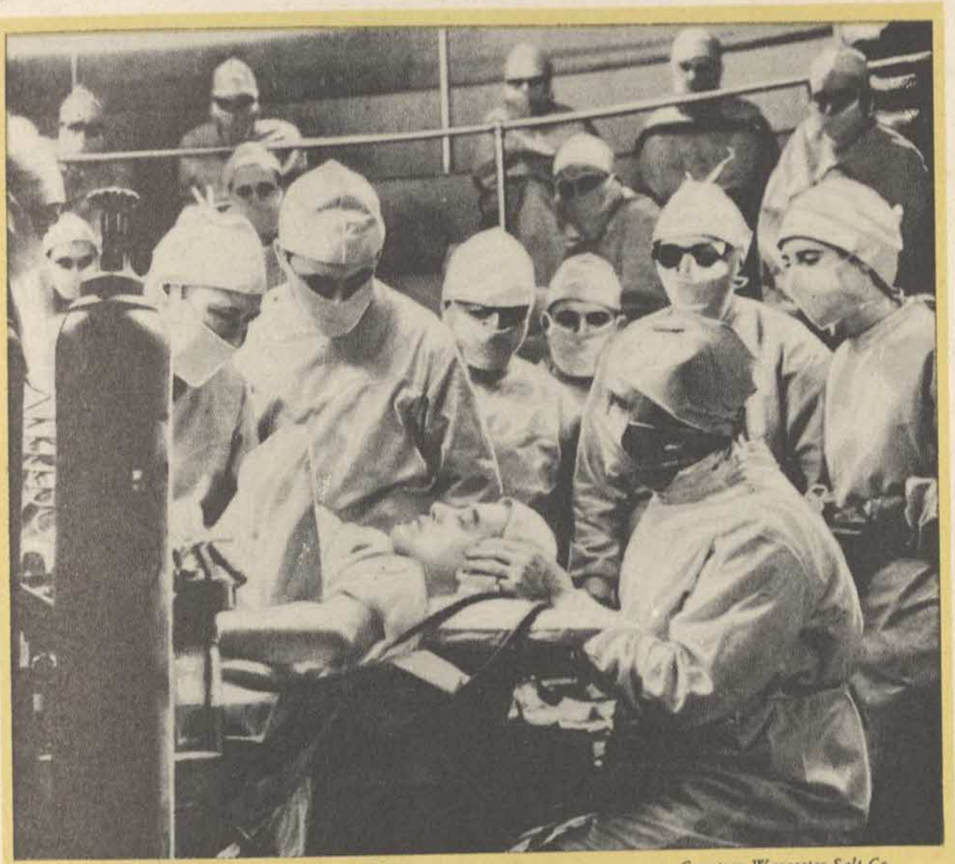
DISINFECTANTS, *dis in fek'tants.* Probably no other single element is so important in preserving and maintaining the health of the world as is the use of disinfectants. Coming from Latin, the term means *without infection* and applies to all substances which have the power to destroy disease germs.

Disinfection is practiced on a large scale in cities where filtration and chlorine are used in purifying the water supply. Serious epidemics of disease would result if drinking water were allowed to flow untreated into city water mains.

Disinfectants in hospitals are of vital importance in treating bandages, surgeons' and nurses' uniforms, and even the hands and gloves of the surgeons. Superheated steam is used in the germ-proofing of bandages; and chlorine, hydrogen-peroxide, and carbolic-acid solutions for ridding the surgeons' hands of any possible germs.

Disinfecting the sickroom after the patient is convalescing is a step of utmost importance in preventing the spread of contagious diseases. This work is done by filling the room with formaldehyde in gaseous form, which kills germ life on curtains, drapes, bed clothing, and furniture used by the patient.

Iodine, hydrogen peroxide, carbolic acid, and boric acid are all simple but efficient home disinfectants. Because many "germkillers" are poisonous, however, they should be carefully kept where children cannot reach them, and bottles containing them should be clearly labeled.



Courtesy Worcester Salt Co.

DISINFECTANTS WIPE OUT SURGERY'S WORST MENACE
Were it not for germ-killing disinfectants, surgical operations would invite infection.

Special disinfectants for treating the eyes, nose, throat, and various other parts of the body have been discovered. These should be administered only by a competent physician.

DISPENSATION, *dis pen sa'shun.* When a member of an authorized Church wishes to be excused from abiding by a Church rule, he must first get a dispensation, or special permit, from a high official of that Church.

For instance, in the Roman Catholic Church a priest may *dispense* one of his parishioners from observing certain holy days if a reasonable excuse can be given. In matters of great importance, however, this power of dispensation lies only with the Pope. Likewise, the Church of England requires a dispensation before a member of the Church can depart from its laws.

Many lodges, too, must secure dispensations from the high authority before carrying on an activity not provided for in its by-laws.

DISRAELI, *diz ra'li,* BENJAMIN, Earl of Beaconsfield (1804-1881). The life of Benjamin Disraeli is as romantic and interesting as the political and historical novels he wrote. In fact, his own experiences were the basis of a number of the books. His distinction as a novelist paralleled his career as a statesman, in which he took part in creating much of the splendor of the British Empire under Queen Victoria.

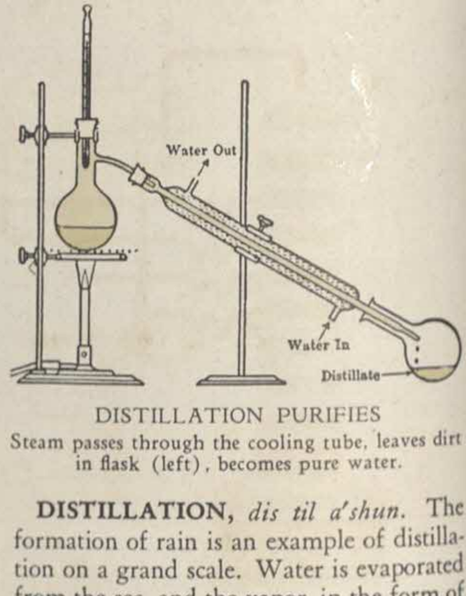
HE MADE A QUEEN AN EMPRESS
Disraeli gained Suez, built British prestige.

Disraeli's father, a well-known student of letters, saw fit to have the family converted from Judaism to Christianity in 1817. The baptism of Disraeli made possible his participation in politics, since the law of the time restricted membership in Parliament to members of the Church of England.

Disraeli was privately educated and at the age of seventeen became a law clerk. But he found law too dull and turned to literature as a career. The first of his novels, *Vivian Grey,* was published in 1826 and was well received. He traveled for a number of years, finally returning to England determined to follow a political career. After repeated failures, he at last succeeded in winning a seat in Parliament at the beginning of Queen Victoria's reign, in 1837.

Between 1844 and 1847, Disraeli published three novels—*Coningsby, Sybil,* and *Tancred*—in which he set forth his belief in the principles of the Conservatives. Winning the leadership of his party, he was appointed Chancellor of the Exchequer in 1852 and was returned to the same office on two other occasions. With the victory of his party in 1868, he became Prime Minister, only to meet defeat in the elections the following year. In 1874 his party was returned to power, and was strong enough to keep Disraeli in office for six years.

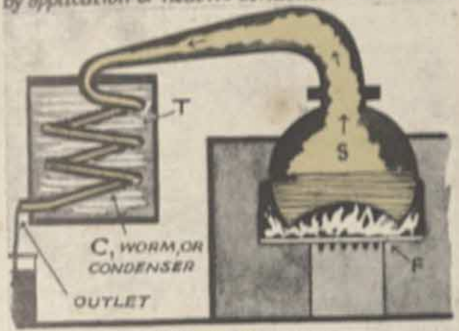
In addition to many reforms within England, he won enduring fame for his brilliant foreign policy. England gained control of the Suez Canal and thus strengthened her position in the East. Russia was kept out of the Mediterranean by Disraeli's success in blocking her encroachments in Turkey under the terms of the Treaty of Berlin. The climax of his career was the proclamation of Queen Victoria as Empress of India. He was rewarded by appointment to the House of Lords, as Earl of Beaconsfield. Disraeli died in 1881, within a year after the defeat of his party.



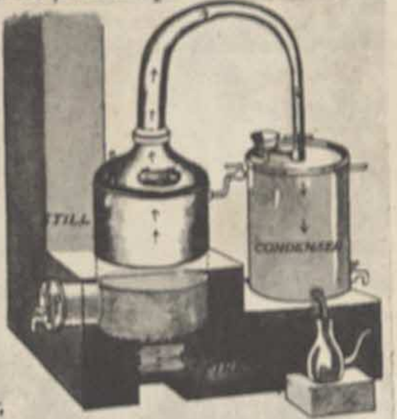
DISTILLATION PURIFIES
Steam passes through the cooling tube, leaves dirt in flask (left), becomes pure water.

DISTILLATION, *dis til a'shun.* The formation of rain is an example of distillation on a grand scale. Water is evaporated from the sea, and the vapor, in the form of clouds, is carried to cooler places. Condensation of moisture then takes place, and rain falls. In most forms of distillation, however, a liquid is boiled or heated to create vapors; these are then cooled and condensed back into liquid form. Distillation has become highly valuable to man, furnishing such important products as distilled water, distilled liquors, and the products of petroleum from naphtha down through kerosene. Moreover, such products as coal gas, ammonia, coal tar, coke, wood alcohol, and acetic acid are obtained by the distillation of coal and wood.

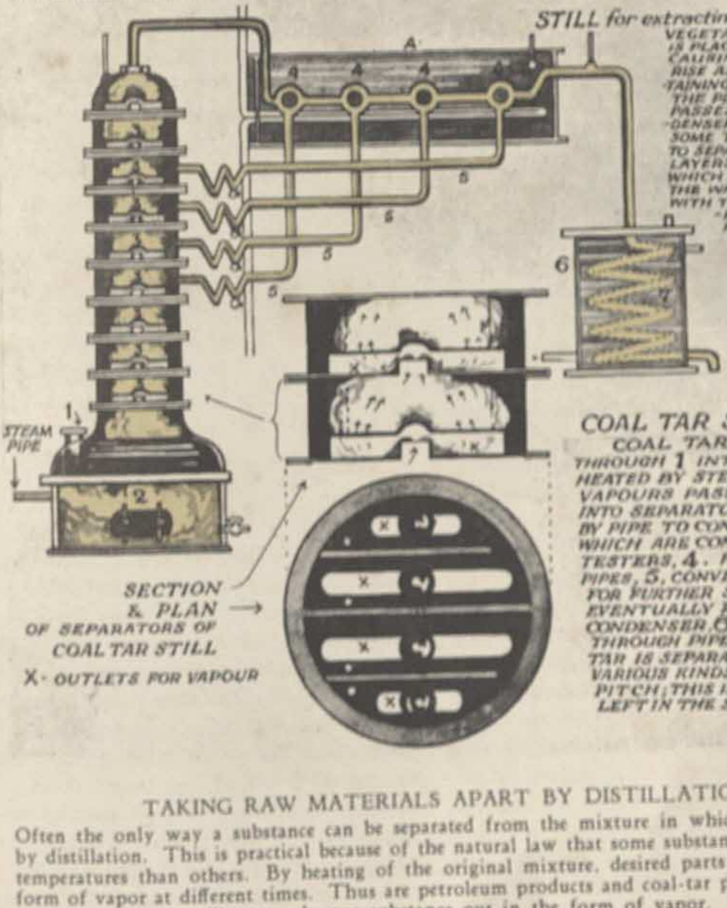
A STILL is an apparatus used for the extraction from a substance of its various parts by application of heat. A Condenser then reduces these parts to liquid form.



A SIMPLE FORM OF STILL
S, STILL OR RETORT CONTAINING SUBSTANCE HEATED BY FIRE, CONNECTED BY STILL-HEAD TO "T" (COOLING TANK), PASSING THROUGH WORM C FROM WHICH IT RUNS INTO RECEIVER BY OUTLET.



STILL for extracting PLANT OILS
VEGETABLE MATTER IS PLACED IN STILL, CAUSING WATER TO RISE AS VAPOUR CONTAINING THE OIL FROM THE PLANTS. THIS PASSES THROUGH CONDENSER & IS LEFT FOR SOME TIME CAUSING IT TO SEPARATE INTO TWO LAYERS, OIL & WATER, WHICH ARE DECANTED. THE WATER, FLAVOURED WITH THE PLANT PERFUME, IS USED IN MEDICINE, & FOR TOILET ARTICLES.



SECTION & PLAN → OF SEPARATORS OF COAL TAR STILL
X - OUTLETS FOR VAPOUR

COAL TAR STILL
COAL TAR IS POURED THROUGH 1 INTO STILL, 2, HEATED BY STEAM. THE VAPOURS PASS FROM STILL INTO SEPARATORS, 3, THEN BY PIPE TO CONTAINER, A, IN WHICH ARE CONDENSING TESTERS, 4. FROM HERE PIPES, 5, CONVEY SOME BACK FOR FURTHER SEPARATION, ALL EVENTUALLY REACHING CONDENSER, 6, PASSING THROUGH PIPES, 7. COAL TAR IS SEPARATED INTO VARIOUS KINDS OF OIL AND PITCH; THIS IS THE DEPOSIT LEFT IN THE STILL.

TAKING RAW MATERIALS APART BY DISTILLATION

Often the only way a substance can be separated from the mixture in which it is found is by distillation. This is practical because of the natural law that some substances boil at lower temperatures than others. By heating of the original mixture, desired parts come off in the form of vapor at different times. Thus are petroleum products and coal-tar products (above) produced. Simple stills get only one substance out in the form of vapor. When the vapor is condensed, there is the desired liquid, in the purest possible form.

Distilling Equipment. Different types of distillation require different kinds of apparatus. In all processes, however, there must be some type of heater to vaporize the liquid; and there must be cooling, or condensing, pipes, usually coiled and surrounded by cold water, to quicken the condensation process. In large industries, this equipment is both elaborate and expensive, but the principle under which it operates is always the same.

Simple Distillation. When a single distillation process is used and the final product is similar to the raw product, the process is known as *simple* distillation. This method, though crude, was effectively used by the early navigators when they produced drinking water free from salt by distilling sea water. Today, modern plants distill water by modern means, but the principle remains the same. The final product, distilled water, is used not only for drinking water but for storage batteries, chemical laboratories, and wherever absolutely pure water must be used. In any process of distillation, only the liquid vaporizes, leaving the minerals, salts, and impurities in the boiler.

Fractional Distillation. When two or more liquids are present in the same solution, they must be separated by *fractional* distillation. For instance, if alcohol and water are present, they cannot be separated in one distillation; they must be drawn off in fractions. Because alcohol boils at about 40° less than water, the first vapors will consist largely of alcohol. Continuing the process, the liquids are further separated in fractions. The separate distillates may then be further distilled and more nearly perfect separations made, though complete separation is next to impossible. This process is used in distilleries for making distilled liquors such as rum, brandy, and whisky.

Of more importance is the use of fractional distillation in the petroleum industry. Petroleum is a peculiar product made up of many substances, and the different products are taken off fractionally. The most volatile (easily vaporized) of these products is naphtha, driven off by the first heating and condensed. The next "cooking" at a higher temperature drives off benzine, which is in turn condensed. Next comes gasoline, then kerosene, and finally the heavier fuel and lubricating oils.

Each of these steps requires the application of more heat than the preceding one, for the vaporizing point of each is higher than that of the preceding one. The residue, or what is left, is used as a coating for roads to prevent dust.

Destructive Distillation. Simple and fractional distillations produce no new substances; the substances originally present are only separated, totally or in part. In *destructive* distillation, however, new substances are created by destroying the raw material. Wood, when heated in a closed oven, gives off vapors from which acetone, acetic acid, and wood alcohol are condensed. The residue is charcoal. When coal is heated, coal gas, coal tar, and ammonia result. The residue of this process is coke. Simple and fractional distillations are ordinary physical processes; destructive distillation is a chemical process because absolutely new products result.

Consult the following titles for additional information:

Alcohol
Carbon
Charcoal
Coal
Coal Tar
Coke
Gas
Gasoline
Petroleum
Wood Alcohol

DISTRIBU'TION. In the United States and other commercial nations, the economic system—the way each person gets his bed and board—is based on individual enterprise; any person may produce goods and exchange them for profit, at his own risk. Thus the private-profit motive has built great businesses with group investments of billions in productive capital. In order to dispose of the goods turned out by such capital, these businesses have designed many different types of distribution systems, most of them now touching the lives of every citizen every day.

A simple form of distribution, in this

DISTRIBUTION—OLD AND NEW
Sellers hauled their own wares to this open air market in Leavenworth, Kan., in 1860. Trains, planes, ships, and trucks are needed to stock a modern shopping center (right).

sense, is the act of a farmer who drives down the road selling his eggs and milk and his garden truck to nearby consumers. More complicated is the elaborate and detailed organization in which the manufacturer of goods sells to wholesalers, who sell to jobbers, who sell to retailers who finally place the goods in the homes of ultimate consumers. All these agencies share in the profit involved in this distribution.

It may be noted that distribution of many common goods to the mass of the people would be either impossible or prohibitive in price were it not for the initiative shown by the manufacturer in keeping both the cost of production and the cost of distribution extremely low through the use of very efficient methods.

Some familiar agencies which reflect efforts to improve and facilitate distribution under this system are: the usual wholesale-retail arrangement already mentioned; brokers, or commission men, who buy and sell for others; direct-by-mail, or mail-order, selling; co-operative groups and chain stores, both of which are organized to keep distribution costs down; salesmen; and advertising, which creates desire, describes goods, and helps get them to the consumer.

A vast system of transportation specialists is engaged in distribution. Trains, ships, trucks, and airplanes carry goods along distribution outlets; the mail, the telephone and telegraph, the cable, and radio assist in the transactions involved; the milkman, the traffic policeman, the bridge tender—even the "sandwich man" with sign displayed on front and back—all play a part in the business of distribution.

In the study of economics, distribution further means the way in which different classes of people in a community share in that community's output of goods and services. The term may also mean the manner in which the value of a product is apportioned among the various agents of production (land, labor, capital, etc.).

See the following articles for related material:

Advertising
Airplane
Automobile
Banks and Banking
Boat
Boycotting
Cable
Capital
Child Labor
Commerce
Communism
Consumption
Co-operation
Corporation
Credit
Customs Duties
Debt
Economics
Embargo
Exchange
Free Trade
Income Tax
Industrial Revolution
Inheritance Tax
Interest
Interstate Commerce Act
Labor, Division of
Labor Legislation
Labor Organizations
Merchant Marine
Monopoly
Radio
Railroad or Railway
Reciprocity
Rent
Sale
Ship
Socialism
Strike
Supply and Demand
Sweatshop System
Tariff
Tax
Telegraph
Telephone
Trade-Mark
Trusts
Usury
Wages
Wealth

DISTRIBUTION OF WEALTH. See WEALTH.

DISTRICT ATTORNEY. In the United States, whenever a case comes to court in which the defendant (person on trial) is charged with violating state laws, the state is represented at the trial by the district attorney. He is the legal representative of the state in the county in which he is an officer. Sometimes he is called a county attorney or prosecuting attorney.

A district attorney of the United States acts as an assistant of the Attorney-General in prosecuting all violations of Federal laws within his district. He is appointed by the President and confirmed by the Senate for a term of four years. The United States maintains district attorneys in the different states and in the outside territories.

DISTRICT COURTS, UNITED STATES. See COURT.

DISTRICT OF COLUMBIA. On a beautiful site along the Potomac River is the District of Columbia, the home of the United States government. This area, originally covering 100 square miles, was ceded to the United States in 1790 by Maryland and Virginia to be used as the site of the new national capital. The portion given by Virginia was returned in 1846; a part of it is now Arlington National Cemetery. The present site contains sixty-nine square miles, and is identical with Washington.

History of the District. George Washington had favored the establishment of the new seat of government on the Potomac. Previously Philadelphia, New York, and other cities had served as capitals (see CAPITALS OF THE UNITED STATES). By a political agreement between Jefferson and Hamilton, this district along the Potomac was selected because it was convenient to the larger cities, offered a superb natural site, and had adequate water transportation to the sea. The city was built after the plans of Major L'Enfant, a French engineer, and was laid out by Major Andrew Ellicott. In the year 1800, Congress held its first session in the District of Columbia. Thomas Jefferson was the first President inaugurated there.

During the War of 1812, the British captured Washington and burned the Capitol, the President's house, and some of the public buildings. After the war, the Capitol and the President's house were rebuilt, and the building of the city was continued on a magnificent scale. With its wide streets radiating from the Capitol, its impressive granite buildings, and its lovely parks, Washington is today one of the most beautiful cities in the world.

District Government. An act of Congress provides that Congress shall govern the District of Columbia. Actually, the governing is in the hands of three commissioners appointed by the President and approved by the Senate. Two of the commissioners are civilians appointed for three-

CENTER OF AMERICA'S ALABASTER CAPITAL CITY

Here in the Capitol the people's government meets, to direct the course of one of the world's great nations. That state and national control be not confused, Washington is in the District of Columbia, governed by Congress. Residents have no vote in the District.

year terms; the third is an army engineer who may not hold the office for more than four years. The commissioners have control over health and police regulations and the appointment of minor officers. All major laws for the District must be passed by Congress, however.

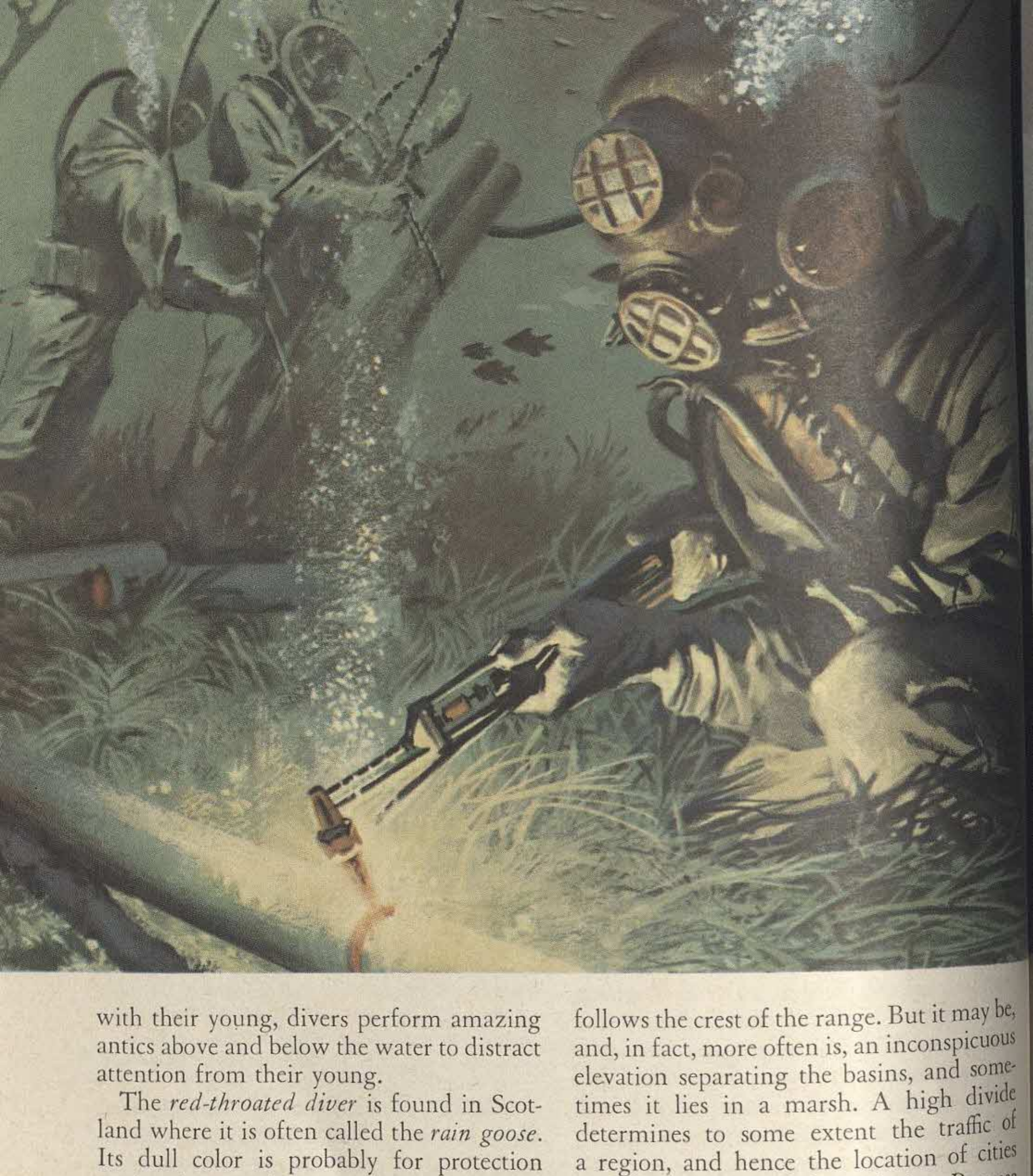
The income for governmental expense is derived partly from Federal appropriations and partly from local taxation. The commissioners must annually submit a report of estimated expenses for the following year to the Federal Bureau of the Budget. The population of the District is about 755,000. Despite their efforts to secure home rule for the District, its residents have no vote, but usually retain suffrage rights in their home states.

For additional information, consult:

Corcoran Art Gallery
Library of Congress
Mount Vernon
National Museum of the United States
Potomac River
Smithsonian Institution
Washington, D. C.
Washington Monument
White House

DIVER. No bird was ever better named than the diver. It will swim about unconcernedly, then suddenly dive and come up with a fish, seldom missing its target. Related to the grebes, divers inhabit the Arctic regions in the warm months, migrating south for the winter.

Best known of these birds is the *great northern* diver, commonly called *loon*. It has a white breast, black-checkered back and wings, and a green and black head and neck, the latter streaked with white. Except for a sharp bill, it is quite similar to a duck. Unusually noisy, the bird has a cry much like rough laughter. When surprised



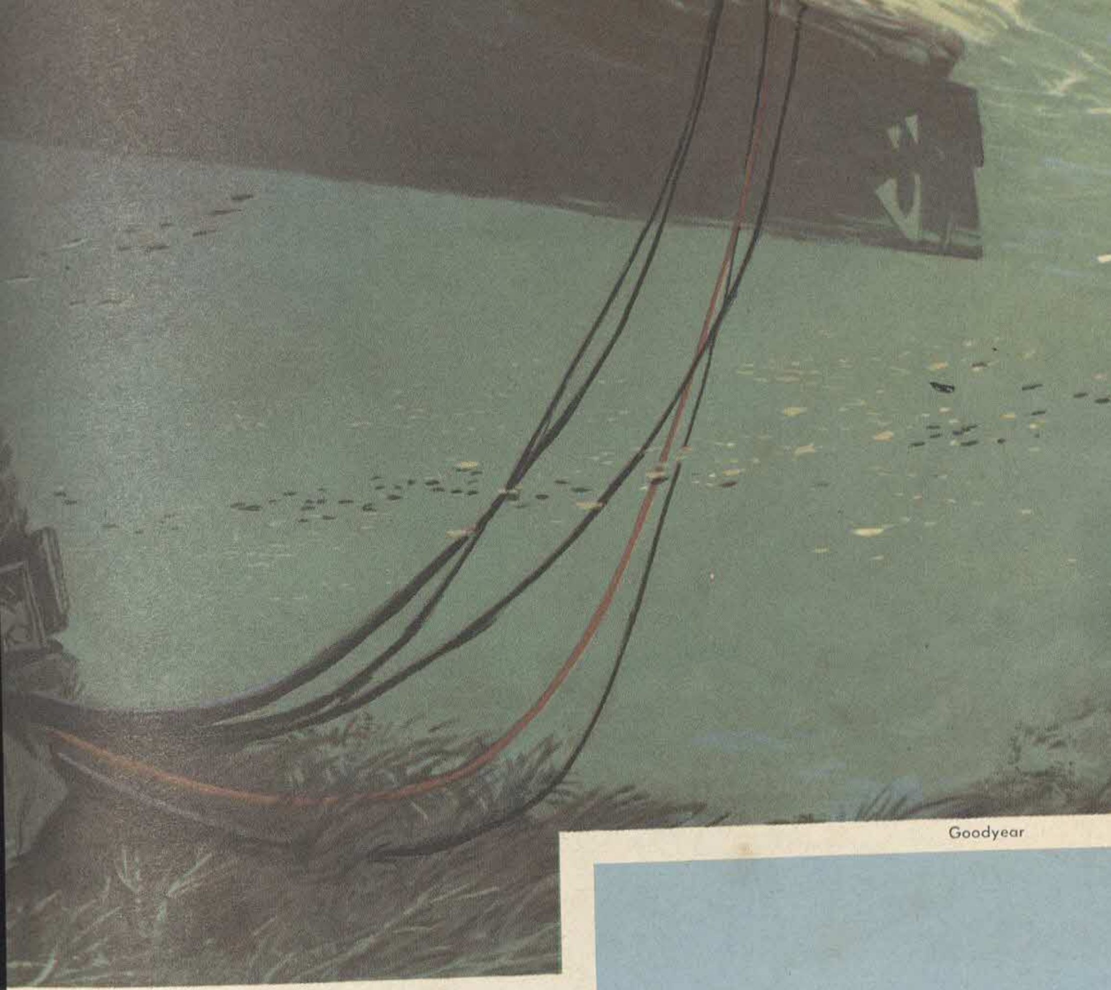
with their young, divers perform amazing antics above and below the water to distract attention from their young.

The *red-throated diver* is found in Scotland where it is often called the *rain goose*. Its dull color is probably for protection against its enemies.

DIVIDE. When rain falls upon a roof, part of the water runs off one side and part off the other, the ridgepole forming a dividing line. In much the same way, the higher land between two or more river basins separates the waters that flow into them, and is therefore called a divide.

The divide is not straight like the ridgepole, nor are its slopes symmetrical. Sometimes it is in a high mountain range, and in this case the divide for the most part follows the crest of the range. But it may be, and, in fact, more often is, an inconspicuous elevation separating the basins, and sometimes it lies in a marsh. A high divide determines to some extent the traffic of a region, and hence the location of cities and the distribution of population. Because they are barriers to commerce, mountain divides often serve as political boundaries, as do the Pyrenees between France and Spain and the Andes between Argentina and Chile.

DIVING. Many people, particularly those in tropical regions, make diving an occupation. Visitors to the South Seas are familiar with the sight of divers who can stay under water for as long as two minutes in search of coins, sponges, and



Goodyear

other objects. They depend entirely upon their swimming ability, and use no special equipment to lower themselves or to stay under the water.

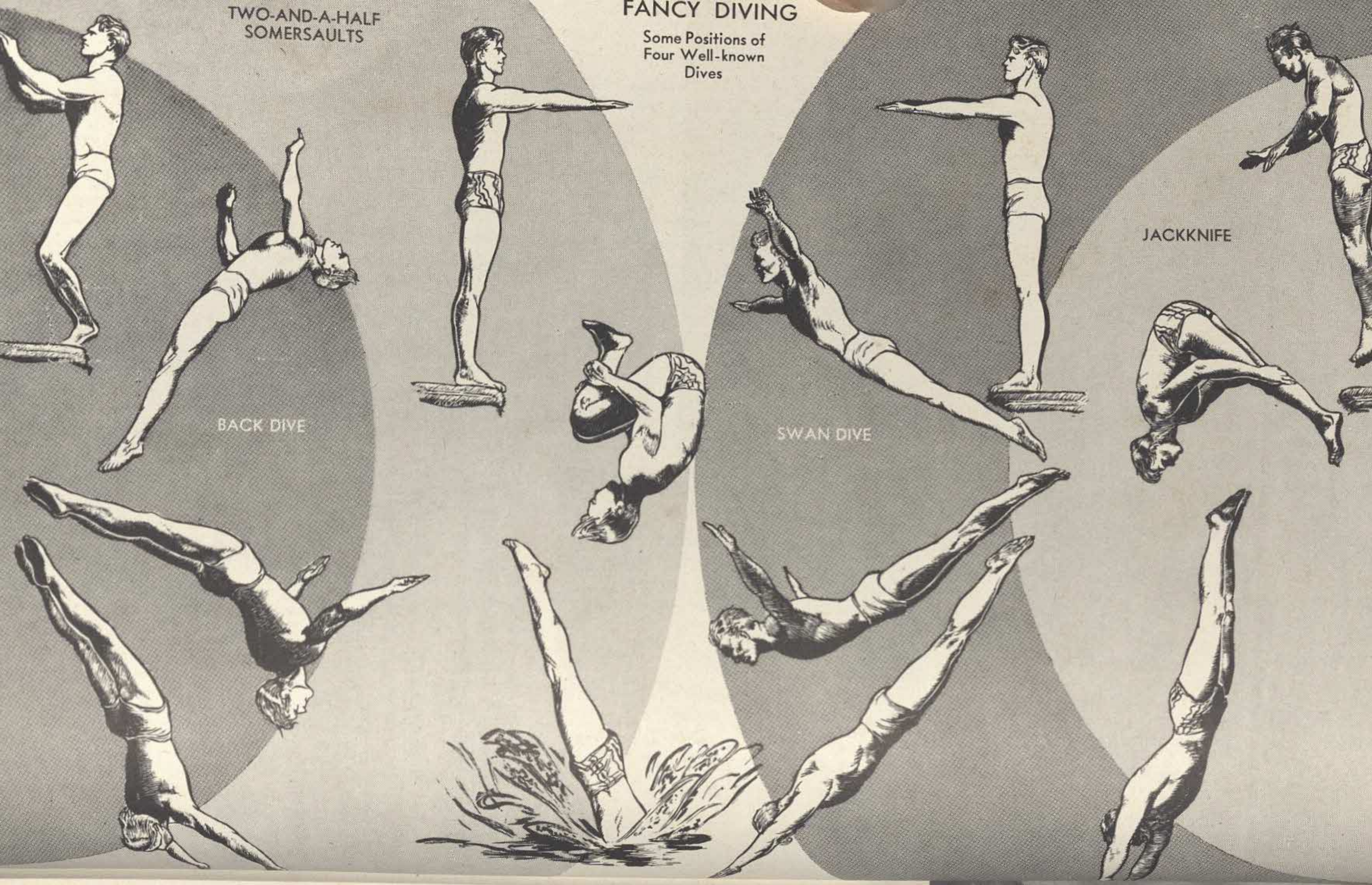
Modern professional and sports divers, however, use a variety of equipment that helps them to reach greater depths and to stay under water longer. The oldest successful apparatus, the hollow sphere called a diving bell, has been replaced by the modern bathyscaphs for use at various depths. In one bathyscaph man has descended almost seven miles into the deepest trench known to exist in the ocean's floor. Other divers, working at depths of a few hundred feet to recover goods lost at sea or working on engineering projects such as bridges and pipelines, wear special diving

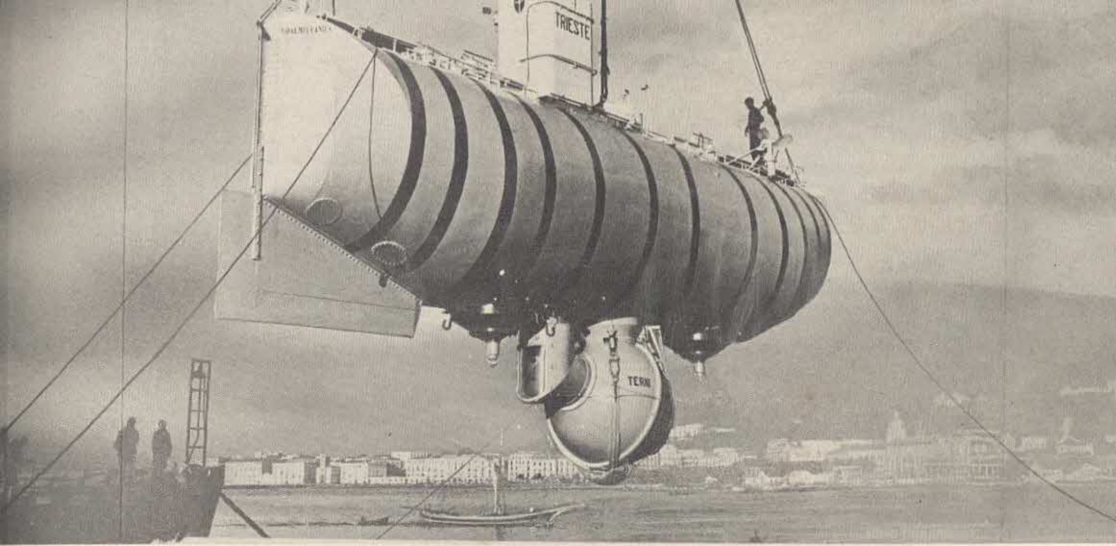
MAN'S SUIT FOR INNER SPACE

Clad in his weird-looking diving suit, a professional diver can descend hundreds of feet through earth's great inner space, the ocean. His air, communications, and fuel are all contained in small hoses connected to a waiting ship. Besides exploring underwater life, modern divers recover sunken treasure and work on engineering projects.

FANCY DIVING

Some Positions of
Four Well-known
Dives





International Nickel Company

FROM THE SHALLOWS TO THE GREATEST DEPTHS
In 1960 the bathyscaph *Trieste* descended almost seven miles into the ocean's greatest depths. Scuba divers, however, are limited to shallow dives by cold, buoyancy, and pressure.

Popular Mechanics Magazine

suits. The suit completely encloses the diver and he receives his air supply through hoses running to the deck of a waiting boat. There are special windows in the suit's helmet and the shoes are weighted to help the diver sink to the bottom and, at the same time, keep his balance. A special communications system enables the diver to talk with other workers under the water or with the ones at the surface. In such suits, divers are able to descend several hundred feet but they must be brought to the surface slowly so their bodies have an opportunity to adjust to the changes in pressure.

In skin diving the equipment consists of a face mask, a snorkel, and flippers. Such divers are limited to dives of about thirty-five to eighty feet. In Scuba (self-contained-underwater-breathing-apparatus) diving, the diver uses a diving lung strapped to his back. This permits him to stay under water for a longer time and to reach greater depths. Scuba divers sometimes wear fleece-lined rubber suits for protection from the cold. In the United States Navy, and in other countries, Scuba divers are especially trained for wartime service, for demolition, for salvage work, and for photography.

DIVISION OF LABOR. See LABOR, DIVISION OF.

DNIEPER, *ne' pur.* Flowing through the Russian wheat belt, this third longest river of Europe serves an area of about 203,000 square miles. It rises between Leningrad and Moscow and follows a zigzag course to the Black Sea. It is commercially important because it is navigable for its entire length of 1,400 miles and has important fisheries.

DNIESTER, *nees' tur.* Rising in the Carpathian Mountains in Poland, the Dniester River enters Russia at Khotin, Rumania. Then it flows to the Black Sea, coursing 850 miles, navigable for most of its length. An important commercial river, it flows through a rich agricultural region.

DOCK. Members of the Buckwheat family, docks are large herbaceous plants found throughout the world. Two common species — the *narrow-leaf* and *broad-leaf docks*—are known in the United States and Canada as troublesome weeds. In England the *broad-leaf dock* is called *butter dock* because the leaves are sometimes used to wrap butter.

DOCKS. The problem of bringing large ocean liners to ports in the United States is comparatively simple. The reason is that there are no high tides, and a ship may be tied securely to a pier which is a long, narrow structure extending out into the water. However, the high tidal range of Atlantic ports of Europe and a few in Canada causes a problem. Here it is necessary to anchor ships in a true dock—a solidly built basin filled with water held at a uniform level by gates or locks. These structures, called *wet docks,* are not influenced by the tides.

Dry Docks. After a ship has been in use for some time, it is necessary to clean its hull and make minor repairs. The ship is put into a dry dock built of strong masonry with swinging gates at the entrance. The ship is floated into the dock, then the water is pumped from the dock leaving the ship supported on wooden blocks and props. Sometimes the entrance is closed by a framework called a *caisson*. There are also floating docks, constructed of wood and steel sections, which can be fitted together to form a basin large enough for a ship.

DOCKYARDS. All the materials required to maintain or construct ships of war are stored in dockyards. Here are the naval stores, tools and equipment to repair warships and the machinery to build new ships. Another name for dockyards is *naval shipyard*. Notable naval shipyards are located at Portsmouth, N.H.; New York, N.Y.; Boston, Mass.; Norfolk, Va.; Philadelphia, Pa.; Charleston, S.C.; Bremerton, Wash.; and in California at Mare Island, Terminal Island, and San Francisco. Canadian dockyards are at Halifax, N.S. and Esquimalt, B.C.

DODGSON, *doj'son,* CHARLES LUTWIDGE (1832-1898). Under the pen name of LEWIS CARROLL, this English author wrote the fascinating stories, *Alice's Adventures in Wonderland* and *Through the Looking-Glass*. He used his real name only when he published scholarly works on mathematics, on which he lectured at Christ Church, Oxford, for twenty-six years. While at the university he became a close friend of the Liddell children, daughters of the dean of Christ Church. Dodgson used to take the "Alice" of the stories and her two sisters rowing, and the delightful adventures in the books are the stories that he told to the little girls on summer afternoons, while drifting down the river. Another favorite is his poem *The Hunting of the Snark*.

DODO. This bird can no longer be found in its favorite haunts on the island of Mauritius. In fact specimens (restorations) of the dodo cannot be found anywhere except in museums, for it has been two centuries since the last one was seen alive. A massive, clumsy creature, perhaps related to the pigeon, the dodo's body was covered with down instead of feathers. The bird was larger than the swan. It had short wings, only a slight tail, and it moved on short, ill-shaped legs. Several skeletons of dodos exist, but for actual appearance we are dependent upon old prints and descriptions left by sailors.

DOG — FRIEND OF MAN IN NEED AND DEED

GOOD SCENTS

For centuries the basset hound has been bred as a sporting dog. It has great ability to scent and flush out game. A loyal hunting pal, it is also a fine pet.

Courtesy All-Pets Magazine—Books, Fond du Lac, Wis.

DOG. For very many centuries the dog has been man's best animal friend. Thousands of years ago, when men made their living largely by hunting game, lone hunters probably welcomed the companionship of an animal. Dogs possessed qualities which made them, more than any other animal, useful and companionable to man. Their sense of smell was stronger than man's, and their speed was greater than man's speed. Their strength was such that, while they were not as powerful workers as horses, they could still be of great assistance, and they were much more intelligent workers.

Dogs could warn man of the approach of enemies, and so made it possible for man to devote to rest or to useful activities, time that might otherwise have been needed to watch for enemies. Dogs also responded to man's many moods. They sympathized with him in trouble and rejoiced with him in pleasures. No other domestic animal has ever equaled the dog in this respect. A dog will forsake his own world for the company of man, to love and serve him above all others.

Partners Through the Ages. With the very first records of man's life, there is evidence of his close partnership with the dog. In the golden age of Egypt, learned men connected the regular re-appearance of a white star of the tenth magnitude with the June beginning of the annual Nile River rise. The Nile floods made Egypt's crops

Gaines Dog Research Center

FAITHFUL AND BRAVE

The German shepherd is versatile and is able to do almost any job that could possibly be expected of a dog. Well known for intelligence and strength, it is often trained in police work, in guard work, and as a guide dog for the blind.

increase by laying a carpet of rich silt upon the valley. Consequently, the Egyptians worshiped the Nile as a god, and the Nile flood's constant, attendant star as a good omen. They named the star *Sirius,* the *dog star,* because it was faithful.

From this ancient honor paid the dog, the peculiar custom of the Israelites in using the word as an insult to others is believed to have grown. The Israelites hated Egyptians; Egyptians loved dogs. Thus, the Israelites thought to call a man a dog was the next worse thing to calling him a Pharaoh. In the same manner, Hindus and Mohammedans, seeing the Christian's love for the dog, called him "dog!" and meant it as a slur. But the dog did not suffer by this rude comparison; his character was set —and it was good.

At first, dogs probably helped man only by guarding the cave, the tree, or the hut, or wherever men slept and kept their families. Gradually, dogs' responsibilities increased. The master grew to expect his dog to be a guard at home and also a helper in hunt and battle. The dog was trained to trail and run down game and to attack his master's enemies, whether they were humans or animals.

Then came specializations. The master acquired herds. The dog then helped tend the herds and so became a shepherd, like the collie with keen eyes and stormproof coat. Another dog proved a fine digger. He and his offspring were bred and trained to help hunt earth-burrowing game, such as the fox and the badger. This type, like the dachshund, developed short legs and long bodies, the better to get into animal dens. These are but a few examples. Today we have specialized dogs just as we have specialists among men.

How the Breeds Vary. We have farmers, laborers, mechanics, teachers, lawyers, writers, doctors, and ministers among men. In dogs, some by training or inheritance are fast enough to outrun the swiftest game. We have wolfhounds and other dogs powerful enough to attack dangerous animals and intelligent enough to work together to

NOT FAR TO FALL

The dachshund is a muscular, active little dog. It is an excellent house pet. With its short legs it is able to get the maximum amount of exercise in the minimum amount of space.

THEY'RE OFF

The whippet, or miniature English greyhound, is the fastest of the domesticated animals for its weight. It is capable of speeds up to thirty-five miles an hour and is popularly used as a racing dog.

Frasie Studio

DEVOTED TO SERVICE

The Doberman pi
often used as a
and war dog. I
sometimes dev
fierce "one-ma
tendencies. Its
ears are the re
of trimming or
cropping wher
allowed. As a
it has larger,
drooping ears.

Courtesy All-Pets Magazine—Books, Fond du Lac, Wis.

"DANE" FROM GERMANY

The great Dane has no particular connection with the country of Denmark. The breed was developed in Germany and in most European countries is commonly called the German mastiff.

Courtesy All-Pets Magazine—Books, Fond du Lac, Wis.

WILLING AND ABLE

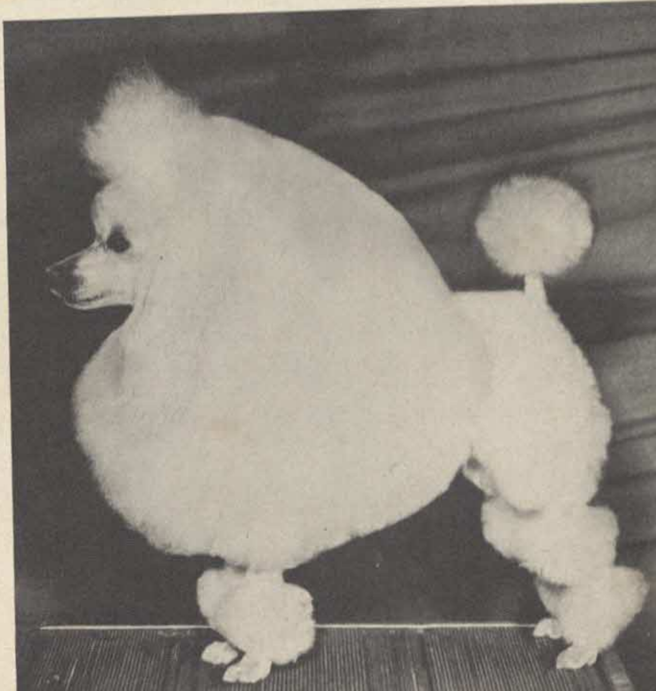
The pug has been described as a big dog in a small package. It has been known to willingly undertake the tasks of its larger cousins. A favorite in Holland for centuries, it originated in China as did other dogs with short faces and curled tails.

Courtesy All-Pets Magazine—Books,
Fond du Lac, Wis.

INTERNATIONAL FAVORITE

Originated in Germany, bred in England, and pampered as a court favorite in France, the poodle has acquired friends all over the world. The tiny toy, trimmed to resemble a lion, is less than ten inches tall at the shoulder.

Frasie Studio



UPI

ALPINE LIFESAVER

Now retired from service, for 300 years the St. Bernard was noted for its life-saving work in the Italo-Swiss Alps.

attack enemies and to corner game.

We have setters and pointers so keen of scent that they can trail particular game in particular ways. We have retrievers which can bring in game where other dogs cannot function. Newfoundlands and Saint Bernards are powerful enough to save human lives. Far to the north, men and their goods are drawn from place to place by teams of dogs that can go where horses cannot. And almost everywhere we find homes guarded by dogs of special training or of no pedigree whatever. We have life-saving dogs working with our armies, and sheep-saving dogs working in our fields, poodles that give us entertainment, and toy dogs that win the affection of ladies of society.

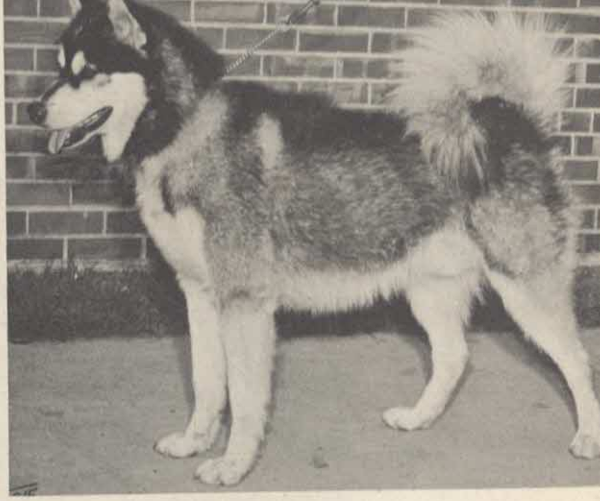
Strange as it seems, all dogs, from the mighty Saint Bernard, weighing 250 pounds to the little Chihuahua of under two pounds, probably came from the same common ancestry. A noted naturalist says: "It is highly probable that the domestic dogs of the world are descended from two well-defined species of wolf, namely, *Canis lupus* and *Canis latrans,* and from two or three doubtful species, namely, the European, Indian, and North African wolves; from at least one or two South American canine species; from several races or species of jackals; and perhaps from one or two extinct species."

Crossbreeding, selective breeding, food, and environment have combined to produce more than 200 recognized breeds—breeds that run true to type. Most of these, by reason of the factors named, have individuality in action as well as in physical features. The greyhound has long, slender legs for speed; the English bulldog is wide and squatty with a flattened nose that permits him to breathe while he keeps his jaws clamped together; the terriers are built strong in the neck and hindquarters so that they can inflict a quick, side-to-side, neck-snapping shake on their prey; water dogs, like the Labrador retriever and Irish water spaniels, have close-lapped, water-resistant coats.

WELL GROOMED

The wire fox terrier is an energetic, stylish dog. To keep its good appearance, its coat must be groomed frequently.

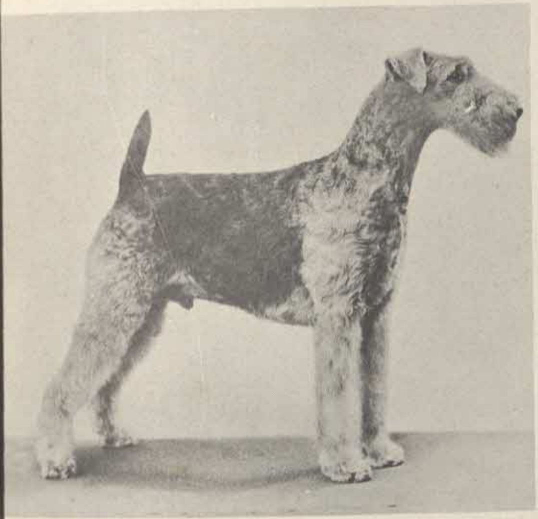
Keystone



Frasie Studio

A FINE PLUME

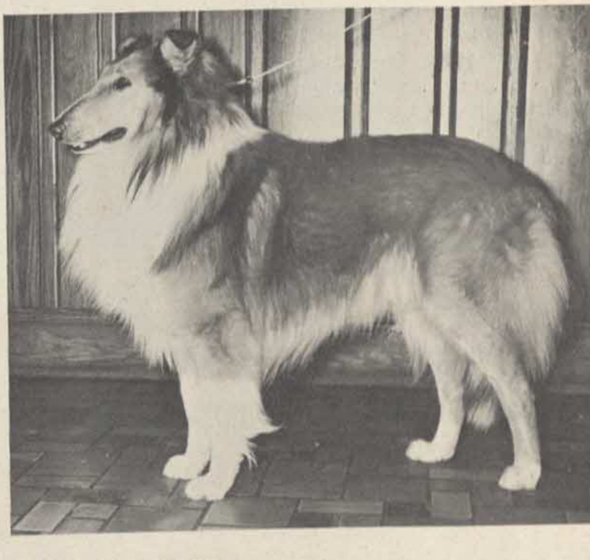
The Alaskan Malamute is one of the oldest breeds used for an Arctic sled dog. Characteristically, it carries its tail arched over its back like a waving plume.



Gaines Dog Research Center

WHEN DUTY CALLS

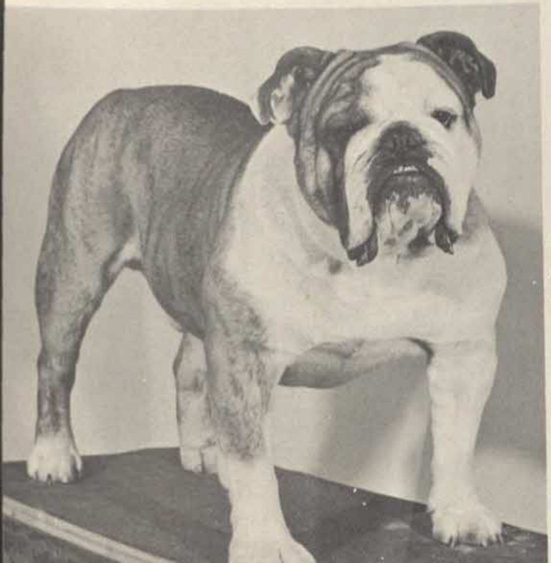
The airedale terrier has a wonderful disposition and is an excellent companion. But it is a brave and tenacious fighter when called upon, and was one of the first breeds used for police duty in Europe.



Ira Mandelbaum

A GOOD SHEPHERD

The collie is known historically for one of the oldest occupations in the world—herding sheep. Today it is popular as a watchdog and a happy playmate for children.



Frasie Studio

NOT AS GLUM AS HE LOOKS

In spite of its challenging look, the English bulldog has a most amiable disposition. It is easily trained to do clownish tricks.

COMING UP FAST

Though still one of the rarer breeds, the golden retriever is fast gaining in popularity.

Wide World

ALONE IN ITS CLASS

The Brittany spaniel is the only pointing spaniel. It is an excellent hunter and its friendliness around strangers and children makes it a good house pet.

Courtesy All-Pets Magazine—Books, Fond du Lac, Wis.

A REAL FIRE DOG

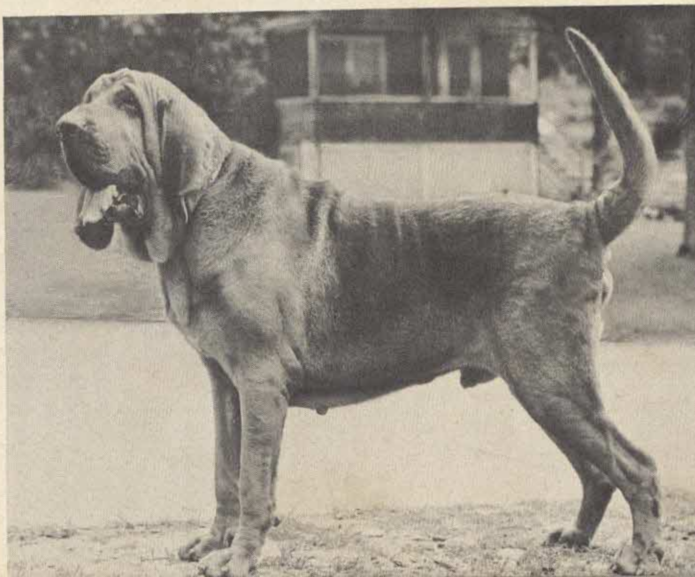
A coach dog, and a war dog of ancient times, the Dalmatian has become famous for its heroic performances while following fire-fighting equipment and as a firehouse mascot. This dog makes an excellent pet.

Courtesy All-Pets
Magazine—Books,
Fond du Lac, Wis.

WRINKLED FOR A REASON

The skin of the bloodhound is extremely loose, especially about the head and the neck. This is thought to be a sort of stretchy armor to prevent the dog's being bitten in a vital part during a fight.

Gaines Dog
Research Center



Gaines Dog Research Center

JUST A LITTLE HOUND DOG

The beagle hound is one of the smallest of the hounds and was bred chiefly for hunting. Today, it is one of the most desirable and affectionate house pets.

How Dogs May Be Classified. Dogs are sometimes classified as *working, sporting, nonsporting,* and *toy* breeds, in the following way:

Working Dogs: Collie, Saint Bernard, Shepherd, Great Dane, Newfoundland, Samoyede, Old English Sheep Dog, Poodles (performing), Schnauzer, Huskie, Doberman.

Sporting Dogs: Setter, Pointer, Foxhound, Greyhound, Whippet, Spaniel, Russian and Irish Wolfhounds, Terriers, Beagles.

Non-Sporting Dogs: English Bull, Chow, Boston Terrier, Dalmatian.

Toy Dogs: Pekingese, Pomeranian, English Toy Spaniel, Chihuahua, Pug, Griffon.

Another Classification, based on physical characteristics, is as follows:

Wolflike Dogs: Large dogs with long, coarse top coats, erect ears. Examples—German Shepherd, Collie.

Greyhounds: Slender, fleet-limbed dogs with short coats. Built for speed; little power of scent. Greyhounds and Whippets are of this class.

Hounds: Medium-size dogs, with short coats, long, hanging ears, long nose, and very keen sense of smell.

Mastiffs: Large-headed, powerful dogs with heavily developed jaws, like the Bloodhound.

Terriers: A special class of dogs of great variety, from small to medium size, with smooth or wire coats. Examples — Scotch Terrier, Kerry Blue, Airedale.

Spaniels: Small to medium size dogs with curly hair and long, silky, hanging ears. Widely used as retrievers in hunting.

Dogs Deserve Good Care. Dogs, like all other pets, are entitled to proper care. They should not be allowed to shift for themselves. It is good training for children to learn to care for dumb animals. It teaches kindness in a practical, effective, and unsentimental way. The care of animals is a responsibility, and the more highly trained the animal, the greater the responsibility. This fact should be kept in mind in choosing a dog. If one does not have the time to give to the training of a dog bred to be highly trained, he should choose a breed that demands only what he feels he can give. If this pet is a female, the responsibility will probably be greater than if a male is chosen.

Whatever our pets need we should give them, and we should remember it is usually we who choose to establish an enduring friendship with the dog, not the dog that chooses to establish the friendship with us. No matter how willing a dog may be to be friendly with strangers, it will stand repeated rebuffs. If we consent to be adopted by a stray dog, we must also assume responsibility for it.

Anyone who owns a dog, or is considering owning one, should know the few simple principles of keeping a dog healthy, handsome, and happy. Booklets and many published works on dog care are available in libraries and from dog food manufacturers. A study of them will be of value to both the dog and its master.

Brief articles on many of the better-known breeds of dogs will be found throughout these volumes under the names of the respective breeds.

ALBINO DOGFISH
Named thus because it stalks its prey like a hunting dog, the Atlantic dogfish is a species of small shark; but this fresh-water dogfish is a bowfin, extremely tenacious of life and destructive to other fishes.

DOG'FISH. From their habit of following their prey like hunting dogs, certain small species of shark have received the name dogfish. These sharks are common in the waters surrounding the British Isles, and the *piked,* or *spiny,* dogfish is the *common* dogfish of New England. The *lesser spotted* dogfish, which is not over two feet long, is caught for its rough skin, which is valued for polishing various materials, especially wood. The *greater* dogfish grows from one to two feet longer and is blackish brown with small spots.

Oil is made from the livers of dogfish found along the coast of the American Pacific. The flesh of some species is edible. Dogfish have cartilage instead of bone in their skeletons.

DOG'TOOTH VIOLET. This spring flower of northern woods is not really a violet. Its common name is one of those peculiar misnomers for which no reason seems to exist, since no part of the plant reminds one of a dog's tooth, and it is a member of the lily family. The name *yellow adder's tongue* is also heard, but only occasionally. Yet it seems to be more appropriate, since the young shoots do have a resemblance to the tongue of a snake. The mottled leaves, however, are more suggestive of a snake skin with its various markings.

Dogtooth violets are among the first flowers to greet us during early spring days. They reach their greatest display in rich, moist woods, particularly on the banks of woodland streams. Although early spring flowers suffer most from wanton picking (probably because they are welcomed so eagerly after the dreariness of the winter landscape), the dogtooth violet is well able to hold its own. The plant is protected by its underground tubers, the nutrition in which is amply replenished by the leaves. Little permanent harm is done by picking the flowers, as long as the entire plants are not uprooted.

DOG'WATCH. On board ships, during the hours from four to six and from six to eight each night, occur the dogwatches. All other watches are four hours in length, but these have been shortened to provide seven instead of six divisions of the day. Thus, the same members of the crew do not have to be on duty during the same hours each day.

DOL'DRUMS. Near the equator, particularly in the vicinity of Brazil, certain parts of the ocean frequently have calms, squalls, and light, uncertain winds. These regions, called *doldrums* by seamen, made navigation difficult in the days of sailing vessels. See CALMS, REGION OF; CLIMATE; WIND.

DOLL. No one knows who the first little girl was who said to her doll, "Now you sit there and don't move until I come back." Nor do they know exactly what her doll looked like. But for thousands of years, little girls in all parts of the world have had some kind of doll, ranging from a plain stick with a knob at one end to serve as a head to the very elaborate dolls of the present day that can walk and talk.

Ancient Dolls. Strangely enough, some of the very earliest dolls did not belong to little girls but were used by the medicine men of primitive tribes in their religious ceremonies. They were constructed of clay and were fat and ugly. They were made to look not only like people but also like ferocious beasts and heathen gods. As man

Wenham Historical Association

ROMANCE OF DOLLS
The doll is nearly 4,000 years old. Originally it had religious meaning (see HOPI); only recently did it become a toy for children. Ancient dolls were carved from stone, bone, and ivory, or they were fashioned in clay and then baked. Most were rigid; a few had movable joints. From these beginnings have come the modern, life-like, clothed dolls of today.

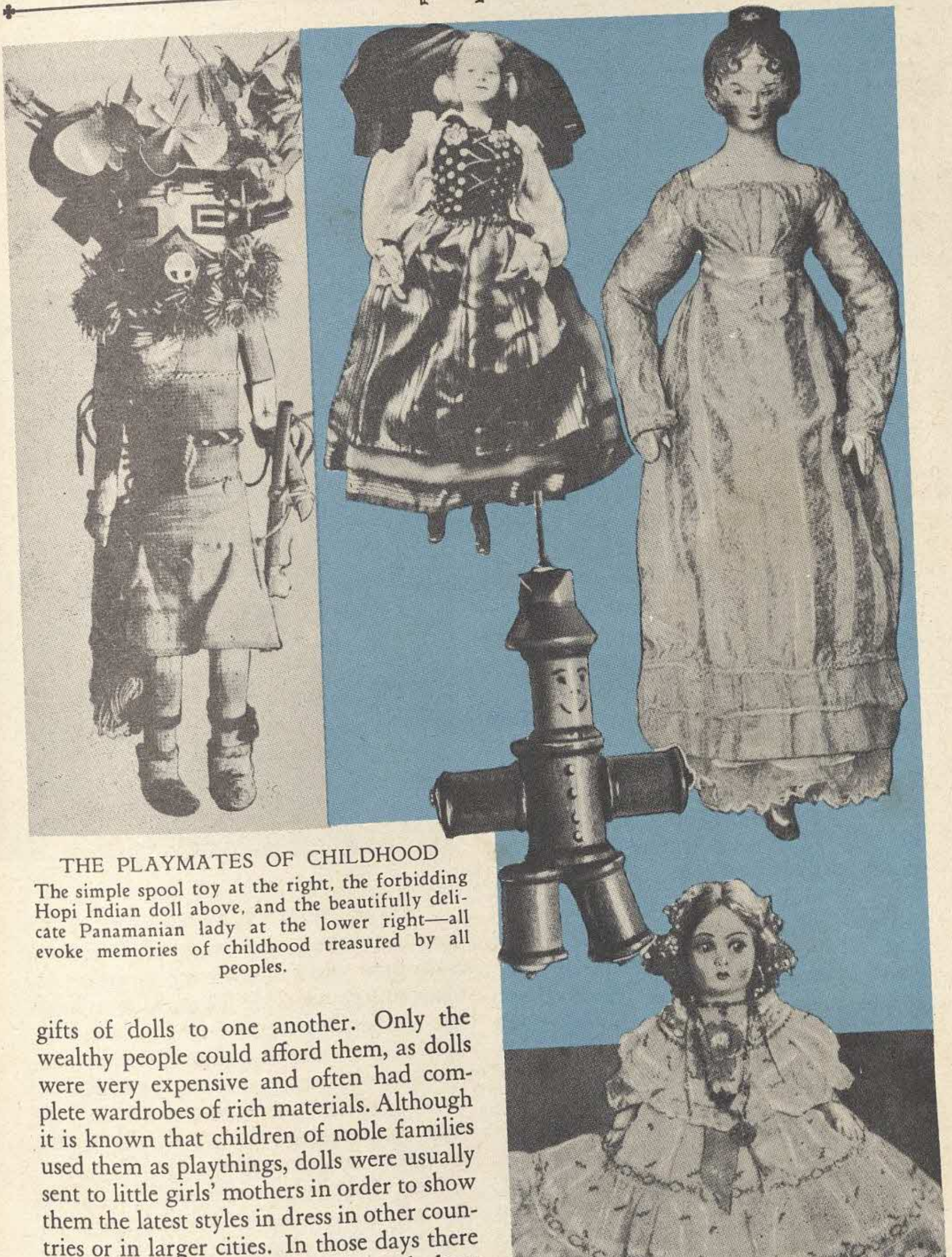
Water-color rendering by Josephine Roman and Edith Towner, Index of American Design, National Gallery of Art, Washington, D. C.

developed in knowledge and culture, dolls came to look more and more human.

In the tombs of the ancient Egyptian kings, little wooden and clay dolls have been discovered. Tiny figures of men and women, cattle, horses, houses, and boats were arranged in scenes portraying Egyptian life.

It was not until the Roman days, however, that dolls were first given as presents to children. Roman dolls were very costly. Some were made of wax and others of wood, and their arms and legs could be moved by pulling a string. Even at this time, however, dolls were closely connected with religious rites and were not used extensively as playthings. Although the name doll goes back to ancient times, the word *puppet*, used now as the name of a certain kind of doll, comes from the Roman word *pupa*, which means *girl*.

Fashion Dolls. Dolls as we know them today became popular between the fourteenth and eighteenth centuries. They were given only as presents to women, and often kings and queens of Europe would make



THE PLAYMATES OF CHILDHOOD
The simple spool toy at the right, the forbidding Hopi Indian doll above, and the beautifully delicate Panamanian lady at the lower right—all evoke memories of childhood treasured by all peoples.

gifts of dolls to one another. Only the wealthy people could afford them, as dolls were very expensive and often had complete wardrobes of rich materials. Although it is known that children of noble families used them as playthings, dolls were usually sent to little girls' mothers in order to show them the latest styles in dress in other countries or in larger cities. In those days there were no fashion magazines; instead, dress designers would dress a doll in the latest creations and send them to their customers. The mothers would copy the designs and give the dolls to their daughters as

United States Rubber Co.

BABY DOLL GETS A BATH

Many dolls are made of a vinyl plastic that feels like human skin. They contain no stuffing and are unaffected by moisture.

playthings. Often dolls were used by hairdressers to show the latest mode of hairdress.

Dolls as Toys. By the beginning of the nineteenth century, dolls had become thoroughly established as playthings for little girls and boys, and manufacturers had begun to make dolls in large quantities. Dollmaking became a large industry in England, France, and Germany; and the dolls themselves had been constantly improved. Wooden heads were discarded for china and papier-mâché, which in turn were supplanted by wax, porcelain, or bisque. The shape of the doll was made more lifelike and bran was used to stuff the kid or canvas body. However, many disastrous accidents occurred when an inquisitive little girl cut the body and all the bran ran out until nothing was left but a shapeless rag.

Walking and talking dolls are much older than most people realize. They were first heard of in 1823 when dolls that said "Mama" and "Papa" as their hands were touched were exhibited at an exposition in Paris. In 1826 the walking doll was introduced along with dolls that could open and close their eyes by means of a weight arrangement. These dolls were not unbreakable as they are today, and were far too expensive for the average child to own. It took almost 100 years for walking and talking dolls to be made cheaply enough so that almost every little girl could have one.

Because these dolls were so expensive, they could be played with only on very special occasions, and even then they had to be handled very carefully. The Japanese girls even today have such dolls, which are carefully packed away except for three days each year when the cherry trees are in blossom. Every little Japanese girl helps her mother unpack and arrange the dolls according to rules that were laid down centuries ago. Then a tea is held at which the dolls are special guests, and at the end of a very elaborate ceremony, the dolls are packed away for another year.

THIS DOLL IS A LADY

She is a Russian doll, made entirely of fabric.

This treatment is very different from that which the average American girl gives her dolls. Her doll goes with her everywhere, shares her adventures, is told her secrets, and is likely to be severely punished when her owner is out of humor. Modern dolls are made to be played with, and consequently the first doll most children remember is a rag or rubber doll which can be treated rather roughly with no harm to doll or mistress.

Boys are given unusual dolls such as clowns, policemen, or animals; and they are just as fond of them as girls are of their baby dolls, even though they may not like to admit the fact. As they grow older, girls like the walking and talking dolls made of composition material.

Dollmaking. Many times it is not the costly factory-made doll that girls love most, but a little wrinkled rag or knit doll that has some special appeal. Mothers all over the world long ago discovered many ways in which to make dolls at home. The little Eskimo with her carved whalebone doll and the Indian girl with her doll of clay are just as happy as is the American child with her costly mechanical doll. Simple dolls have been constructed of milk bottles, corncobs, peanuts, spools, clothespins, and the like. On rainy days little boys and girls spend hours cutting out paper dolls.

Many little girls learn to sew by making clothes for their dolls, and curtains and rugs for their dollhouses.

Doll Collections. There are several large collections of old and famous dolls in the United States and Europe. Many famous collectors live in Paris, which has long been the center of the world's dollmaking industry. Queen Marie of Rumania had a large collection, and Eugene Field, the poet, also collected dolls. The Fairchild collection at Madison, Wis., and that at the Smithsonian Institution in Washington contain interesting and valuable early American dolls.

There are also many famous private collections. Almost all the historical museums in the United States have dolls on display, where one may see dolls of all periods, including the woven dolls of ancient Peru and Bolivia, the homemade dolls and furniture made by pioneer American fathers, and the lifelike dolls of today.

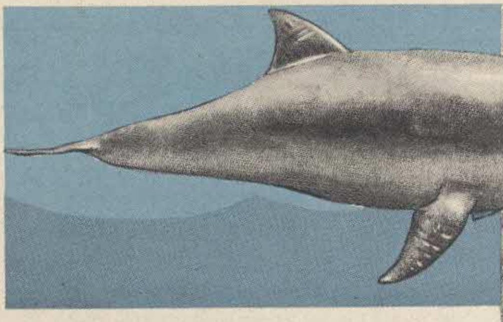
DOLLAR. With a stated value of 100 cents, the dollar is the unit of the monetary systems of the United States and Canada. Based on the decimal system of coinage, the dollar was established as the monetary unit of the United States by act of Congress under terms of the Currency Act of 1792. The first silver dollars in the United States were issued in 1794.

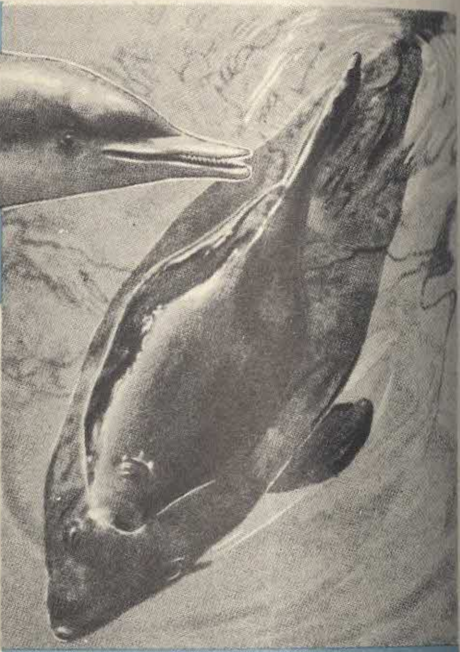
The name dollar was derived from the Dutch *daler* or German *thaler,* but the coin used in the United States was copied from the Spanish dollar. In February, 1873, Congress passed an act which made the gold dollar the standard in the United States; it was coined for several years, but because it was small and inconvenient to handle, it has been discontinued. In April, 1933, the Federal government called in all gold, and since then there has been no gold coin in circulation. Silver dollars are most common in the western part of the United States, and in many cases are preferred to paper money. Because they are large and heavy, no silver dollars have been coined since 1935. See COINS AND COINAGE; MONEY.

DOL'OMITE. Composed of carbonates of calcium (lime) and magnesium, dolomite is a mineral compound found as crystals and in large masses as rock. There is complete gradation between limestone and dolomite, and for most uses—except for making portland cement and for flux in smelting ores—it makes little difference which is taken. Much rock called limestone is partly or wholly dolomite.

The name Dolomites has been given to a range of the Alps between the Tyrol and the province of Venice, because the mountains consist of this mineral.

DOLPHIN, *dol'fin.* Playing around the bows of ships in almost any sea may be seen this sharp-snouted sea mammal, relative of the porpoise and the narwhal. Because of its disagreeable flesh, the dolphin has no particular commercial value, although it is sometimes used for food by the Laplanders. From six to seven feet in length, it is usually black above, gray on the sides, and white underneath. Breathing from the surface of the water, the mammal has an ear very sensitive to





A DEEP-SEA RACER

Black and slender, the dolphin is characterized by tremendous speed and strength.

sounds, particularly harmonious ones. The dolphin is a fast swimmer, having little trouble keeping abreast ships, and even finding time to splash about. It feeds on fish and mollusks.

Sacred to the god Poseidon in Greek mythology, this creature appears on a number of early Greek coins. Three dolphins formed the crest of the early lords of Dauphiné in France, from whom was derived *dauphin,* the name for the French heir to the throne. See DAUPHIN.

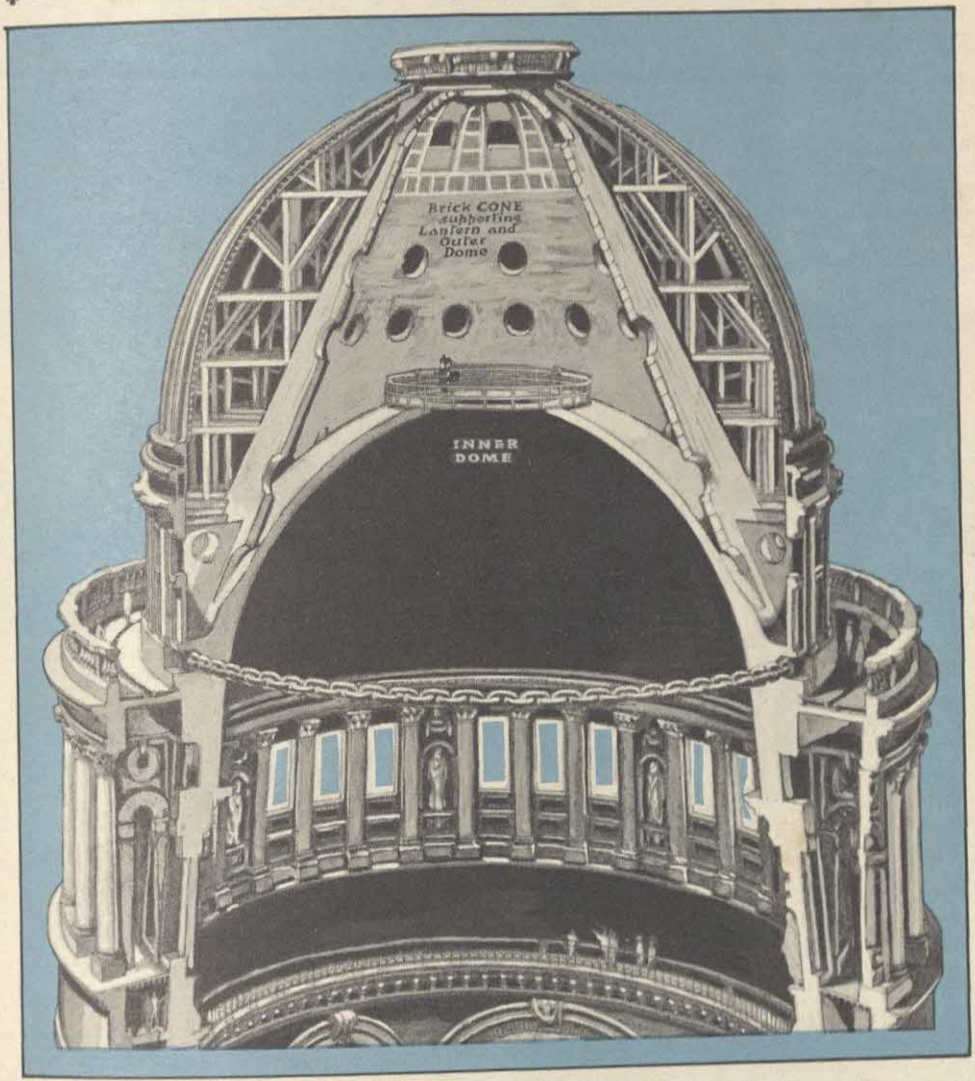
DOME. The rounded top of Saint Peter's Church at Rome or that of the United States Capitol is called a dome. This feature of architecture, which was especially developed in the Byzantine and Renaissance periods, consists of a vaulted roof ranging from a semicircular form to a nearly complete hemisphere. A dome does not require center supports, but depends on its own structure.

The finest example in the world, ancient or modern, is that atop the Pantheon in Rome. This dome is 140 feet in diameter and 143 feet high, and is in excellent condition. The dome of the United States Capitol measures ninety-six feet in diameter and is the largest in America.

DOMESDAY, *doomz′day,* **BOOK, or DOOMSDAY BOOK.** A survey of all the land in England under the rule of William the Conqueror was compiled about 1086 in the Domesday Book. William, England's first Norman king, appointed commissioners to collect the material from public officials, manor lords, and serfs in each district. The records furnish full details as to tenure, value, and proprietorship of the land, and give us valuable information as to social conditions and culture existing in various sections of the kingdom. The survey excludes certain territories, probably because the royal authority was not fully established there. The Domesday Book is the most complete and detailed survey of Norman England in existence, and has been twice republished.

DOMESTIC SCIENCE. See HOME ECONOMICS.

DOMINICAN, *doh min′ i ḳan,* **REPUBLIC.** Occupying the eastern two thirds of the island of Haiti, the Dominican Republic has an area of 19,332 square miles, about twice the area of Vermont. Although its rugged face is ribbed by mountains, agriculture is the dominant industry; and great quantities of tobacco, sugar cane, cacao, and coffee are raised. The Republic is well forested with valuable timber, including mahogany, logwood, cedar, and satinwood. Rich mineral deposits include coal, iron, copper, and gold, but they have not been developed.



THE DOME—TRIUMPH OF THE ARCHITECT'S SKILL

This diagram shows how the dome of Saint Paul's Cathedral in London is constructed. Foundation weaknesses have made the dome insecure, so great chains have been circled about the structure to counteract the downward thrust of the weight of the dome.

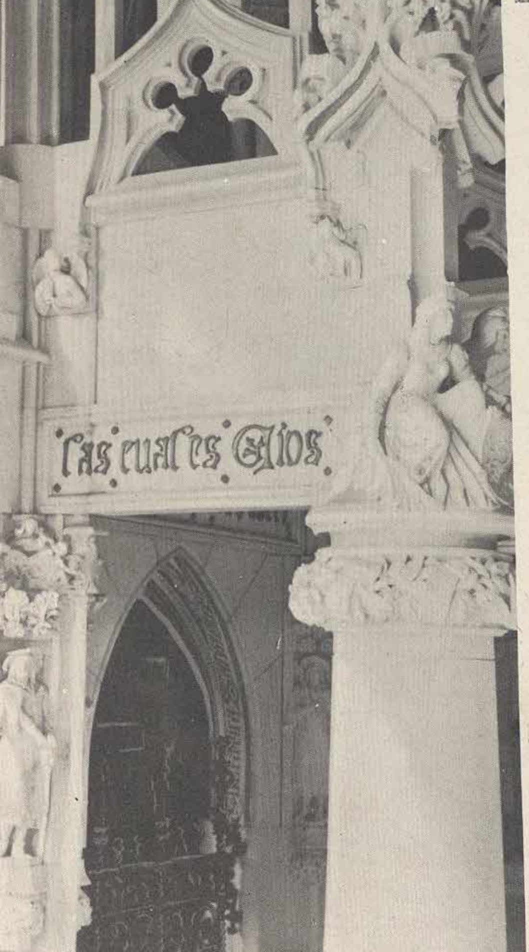
Government and Education. The inhabitants of the Dominican Republic are of Spanish, Indian, and Negro blood. The prevailing religion is Roman Catholicism; the language, Spanish. Declaring themselves independent of Haiti in 1844, the people set up a republic. Under the revised Constitution of 1924, the government is administered by a President, elected for four years, a Cabinet of seven members, a Senate of twelve members serving four-year terms, and a Chamber of Deputies of thirty-three members, elected for four-year terms. Each of the twelve provinces is ruled by a governor elected by direct vote.

Grade, high, and normal schools are maintained by the state, and primary education is compulsory.

Three Lions

HE CRADLE OF AMERICA

t, looking like a dancer grass skirt, a worker es sisal fiber at his while he attaches the ends to a bobbin in ng rope by hand. Be- Ciudad Trujillo hon- he tomb of Columbus this beautiful shrine in its cathedral.



Industry and Transportation. Agriculture is the chief source of the country's wealth, and sugar cultivation is the leading industry; there is very little manufacturing. Transportation is poor; there are only about 170 miles of public railroads and 650 miles of private lines on the large estates. There are but 1,300 miles of telegraph lines owned by the Republic.

History of the Republic. The Dominicans were ruled by Spain until 1821, by Haiti between 1822 and 1844, and by Spain again between 1861 and 1865. When the Republic had trouble repaying foreign loans in the early 1900's, the United States took over collection of its customs duties and occupied the country between 1916 and 1924 during a period of internal strife.

General Rafael Trujillo became dictator in 1932. He conducted public works and beautified the capital of Ciudad Trujillo, formerly Santo Domingo. But he also limited civil liberties, and economic conditions were poor. In 1960, Trujillo was censured by the Organization of American States for aiding attempts to overthrow the government of Venezuela and for improper treatment of diplomats from Ecuador. The United States and other American states broke off diplomatic relations and applied sanctions. The Dominican Republic has about 2,843,000 people and Ciudad Trujillo, 273,000.

DONATEL'LO, or DONATO, *do nah' toh* (about 1386-1466). The founder of modern sculpture, Donatello was a famous Italian sculptor during the early Renaissance. So important was his work that he influenced not only sculpture but other forms of art as well.

Donatello was born at Florence and was the son of a wool merchant. Not much is known of his boyhood. He did, however, make the acquaintance of Brunelleschi, the noted architect, who is said to have influenced him to study at Rome. Returning to Florence, he produced two marble statues —*Saint Mark* and *Saint George*. In 1433 he was again in Rome for a time, where he became a believer in realism in art.

He was a master in the use of bronze as well as marble. Two of his famous works were cast in bronze—*Gattamelata* and *David*. *Gattamelata,* cast in 1447, was the first bronze equestrian statue since ancient days, and it created a sensation.

In reliefs, too, Donatello became famous. Among other works in relief was the *Dancing Angels,* on the pulpit of the Cathedral of Prato.

Donatello was revolutionary in his work at a time when most other artists were bound by conventional ideas. His work was true to nature, however, at the same time having individuality.

DONKEY. See Ass.

DON QUIXOTE, *don ke ho'tay*. Amusing, half-mad Don Quixote, launched on a career of knight-errantry with a suit of rusty armor, a pasteboard helmet, and a draft horse, is only a character in a novel by Miguel de Cervantes, published in Spain in 1605 and 1615. But the witless knight is referred to so often, in speech and in writing, he really seems to have lived. The book is one of the great classics of both Spanish and world literature.

Don Quixote takes part in a series of adventures that are romantic only in his own imagination. In one episode, he imagines that a number of windmills are giants, even though his servant, Sancho Panza, tells him the facts. He attacks the "giants," only to be thrown from his horse by the moving blades. Even in "defeat" he is undaunted, for he says that an evil spirit changed the giants into windmills as he was attacking them. From this incident comes our familiar expression, "tilting at windmills."

The book was written to ridicule the many novels of romance and chivalry that were being produced in the early seventeenth century, but it became one of the most entertaining satires on human nature ever written. See CERVANTES, MIGUEL DE.

DO'RIANS. There were four great branches of the early Greeks. Among them were the Dorians, who came from Thessaly about 1200 B. C. and settled for a time in Doris, a mountainous area in Northern Greece. They settled eventually in the Peloponnesus, where the Spartans became their outstanding representatives. See GREECE; SPARTA.

DORIC ORDER. See COLUMN; and illustration under ARCHITECTURE, page 172.

DOSTOIEVSKY, *dahs to yef'ske,* FEODOR MIKHAYLOVICH (1821-1881). Ranking with Tolstoi among the forceful and influential novelists of Czarist Russia, Dostoievsky is best known for his realistic novels, *Crime and Punishment* and *The Brothers Karamazov*. Raising realism to its highest plane, making real life more important than plot, he wrote *The House of the Dead*. One of his most popular books, this was produced while Dostoievsky was exiled in Siberia for activity in the socialist cause. He had been an officer of the Imperial army. *Poor Folk,* his first attempt at novel writing, was successful, but the second, *The Double,* lacked literary appeal. Later novels, however, brought him fame.

DOUGLAS, STEPHEN ARNOLD (1813-1861). During the fateful years when the North and South were drawing apart on the issues of slavery and states' rights, Stephen A. Douglas was a commanding figure in the oratory and legislation of the United States Senate. He was so small of stature but so powerful a speaker, his friends called him the "Little Giant." Douglas was born in Vermont, but throughout his entire political career he was a citizen of Illinois; and it was his lot to defeat in a debate and be defeated for the Presidency by another great citizen of Illinois—Abraham Lincoln.

Douglas was admitted to the Illinois bar in 1834 and began practice in Jacksonville. Within a year he became prosecuting attorney for his district, starting his career as a Jacksonian Democrat. Until his death he was an outstanding leader in that party, which elected him to the House of Representatives in 1842 and to the Senate in 1846.

CHAMPION OF STATES' RIGHTS
Stephen A. Douglas, the "Little Giant," father of the doctrine of "popular sovereignty."

When Douglas was appointed chairman of the Senate Committee on Territories, he was swept into the slavery controversy, an issue which raised him to the heights and yet defeated him, and also tore asunder the states which he strove to keep together. Douglas was a strategist, willing to consider any compromise which might in some measure satisfy both sides. But with one group in favor of extending slavery to the newly created states and territories, with another opposed to such extension, there was little chance for a successful compromise.

Desiring to retain the support of both the North and the South, for his goal was the Presidency, Douglas introduced into Congress the doctrine of squatter or popular sovereignty. In other words, the citizens of each territory had the right to determine, through their representatives, whether slavery should be allowed or not. In this connection, he ardently supported the Kansas-Nebraska Bill, as reported by his committee.

When Douglas ran for re-election to the Senate, in 1858, his opponent was Abraham Lincoln, a rising Illinois lawyer who had served one term in Congress. The two engaged in a remarkable debate on the issues of the day. Lincoln forced Douglas to take a stand on the slavery question that made the South turn against him. although Douglas won the immediate prize—re-election to the Senate. In 1860 he was nominated for the Presidency by the Democrats in the North, but lost the election to Lincoln. When the Civil War began, Douglas supported the new President.

DOUGLAS, WILLIAM ORVILLE (1898-). The youngest Supreme Court Justice appointed since 1811, William O. Douglas succeeded Louis D. Brandeis in 1939. Douglas was born in Maine, Minn., but went to the state of Washington in his boyhood. In 1920 he received his A.B. degree at Whitman College, Walla Walla. After teaching in the Yakima high school, he went to New York, where, in 1925, he received a degree in law at Columbia University. Douglas taught law at Yale and became an authority on corporate reorganization. From 1934 to 1939 he was a member of the Securities and Exchange Commission, becoming chairman in 1936. He is a left-wing liberal.

DOUM PALM, *doom pahm.* To the poorer natives of Upper Egypt and Central Africa the doum palm is a source of food.

"WESTWARD THE STAR OF EMPIRE TAKES ITS WAY,
THE GIRLS LINK ON TO LINCOLN,
THEIR MOTHERS WERE FOR CLAY."
ABE THE GIANT-KILLER
THE LITTLE GIANT CHAWING UP OLD ABE
FREE TERRITORIES AND FREE MEN,
FREE PULPITS AND FREE PREACHERS,
FREE PRESS AND A FREE PEN,
FREE SCHOOLS AND FREE TEACHERS

THE MAKING OF HISTORY

In their famous debates, Lincoln and Douglas brought into the open the arguments for and against states' rights. The issue, a landmark on the road to war, aroused discussion from one end of the nation to the other.

Its fruit, about the size of an apple, has a rind tasting like gingerbread. The palm can be recognized by its stems, which branch repeatedly. At the ends of the stems are large fan-shaped leaves borne in tufts.

DOVE. Members of the pigeon family, the doves avoid group life, preferring to live together in pairs. The notable species are the *mourning, ring, scaled,* and *ground* doves. The mourning dove, which is related to the European turtle dove, owes its name to its cooing notes, which are really the mating call.

Throughout legend and poetry, the dove appears as a symbol of innocence, love, and peace. The bird has occupied a place in many religions, particularly in Christianity and its art. The dove was chosen as Noah's messenger from the Ark; a dove rested on the head of Jesus after His baptism; and Saint John saw the *Spirit* descend from Heaven in the form of a dove. See TURTLE DOVE.

SYMBOL OF PEACE AND LOVE

A common variety is the gray and brown turtle dove.

DOVER, DEL. Lying in the geographical center of Delaware is Dover, capital of the state and county seat of Kent County. It is located on the Saint Jones River, a small unnavigable stream, and is eight miles south of Wilmington.

Among the leading industrial plants of the city are fruit canneries and driers, machine shops, foundries, and sawmills. Wesley Collegiate Institute and the State College for Colored Students are located here. The state, county, and post-office buildings, of colonial design, are notable edifices.

Dover was founded in 1717, made capital of the state in 1777, and incorporated as a town in 1829. It has a population of about 7,300.

DOVER, Strait of. Separating Calais in France and Dover in England is the Strait of Dover, one of the busiest small bodies of water in the world. A part of the English Channel, the strait is about twenty miles across at its narrowest point. Guarding the narrow inlet on both the French and English sides are chalk cliffs, very similar in appearance. During World War I, great steel nets were stretched across the strait by the Allies to blockade the German submarines. At the same time it was proposed to dig a tunnel under the strait; but this plan has never been carried out. See English Channel.

DOYLE, Arthur Conan, Sir (1859-1930). Sherlock Holmes, master detective of fiction, was the creation of A. Conan Doyle, a Scottish doctor who forsook his practice to become a novelist.

Born in Edinburgh, and educated there and in England, Doyle practiced his profession at Southsea until he was an established writer. His first notable success, *A Study in Scarlet,* was published in 1887. His master detective was an immediate success, and in 1892 he decided to devote his time to describing the life of this pipe-smoking violin-playing crime detector. Holmes and his friend, Dr. Watson, are the central figures in the series of stories, which include *The Adventures of Sherlock Holmes, The Hound of the Baskervilles, The Return of Sherlock Holmes, The Memoirs of Sherlock Holmes, The Sign of the Four,* and *The Case Book of Sherlock Holmes.*

Apart from detective stories, Doyle wrote *Micah Clarke, The White Company, Sir Nigel,* and other historical romances, as well as plays, verse, and short stories. He was senior physician in a field hospital in the Boer War. He wrote histories of both the Boer and the First World wars, in the former defending the British policy.

Losing his eldest son in the war, Doyle hoped to communicate with him from beyond the grave and took up spiritualism. His books on this subject include the *Wanderings of a Spiritualist, Our American Adventure, A New Revelation,* and *A History of Spiritualism.*

DRACHMA, *drak' mah.* In ancient Greece the drachma was the principal silver coin, varying in weight in different parts of the Greek world. In Attica it had a weight of 67.4 grains. Modern Greece has a coin of this name, which originally was of the same value as the French franc, or 19.3 cents in American money. But from time to time its value changes. In 1954 a drachma was worth about 3.3 cents in American money. The drachma is divided into 100 lepta.

DRA'CO. Before the time of Draco, a statesman of ancient Greece, the people of Athens had no written laws. Local rulers punished criminals as they saw fit, and since this practice led to much injustice, Draco was called upon to draw up a code of laws. He believed the way to prevent crime was to provide extremely cruel punishment, and under his laws almost every crime meant death. The Athenians were subject to the merciless laws of Draco about 600 years before Christ. These laws were replaced eventually by the code of Solon, Athens' greatest lawmaker. See Solon.

DRAFT. In the United States and Canada, drafts are used chiefly to collect sums of money that are due in business transactions. Three people are involved when a draft is presented; for a draft is an order written by one person directing the second person to pay a specified sum of money at a certain time to the third person.

Although drafts are usually issued and collected through banks, private individuals may carry through the whole operation of a draft. As an example, three accounts may be satisfied with only one exchange of money. A may issue a formal draft asking B, who owes him money, to pay $50 to C, thus reducing B's debt to A by the amount of the draft. A would give the draft to C, to whom he is in debt, and C would present the request to B, who finally would pay it.

If a draft is drawn payable *at sight,* the receiver may indicate his willingness to pay by writing his acceptance and signature across the face of the draft, which then becomes equivalent to a note. These are called *sight* drafts. Another kind is a *time* draft, which is payable a certain number of days after it has been presented. A person who receives a draft is not obliged to pay it, but he probably will pay it in order to maintain a good credit record with his bank. However, a person who does not pay a draft can be sued in court without any further notice. If, after accepting a draft, a debtor fails to pay, the bank may make an affidavit of the circumstances. This procedure is called *protesting the draft,* the cost of which the debtor will eventually have to pay.

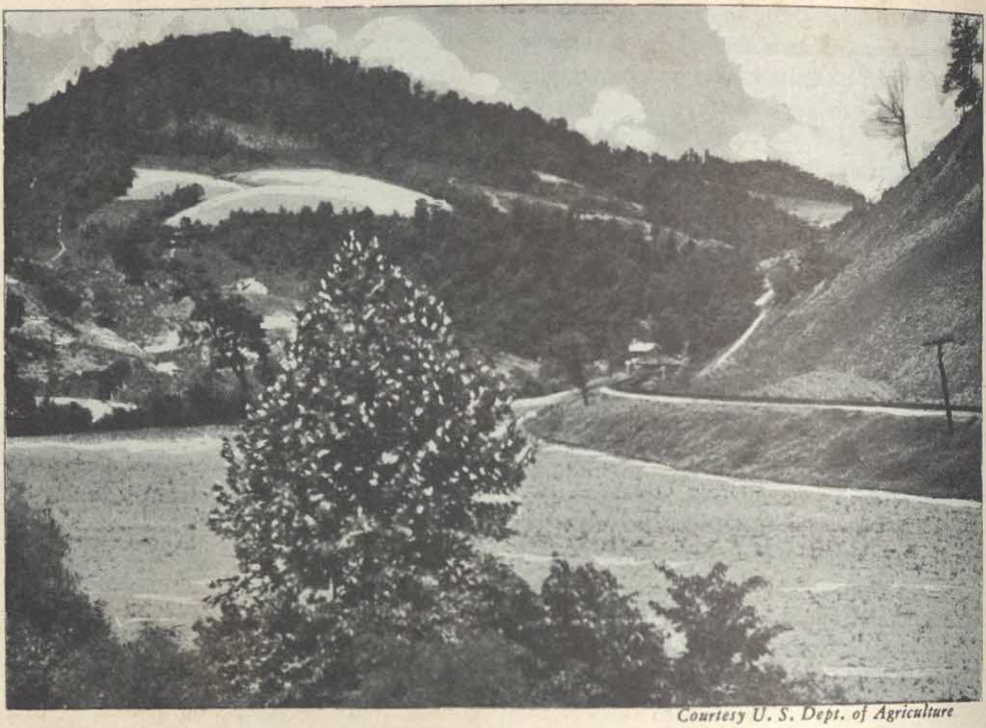
DRAG'ON. The dragons of mythology were supposed to be fierce, fire-breathing, scaly beasts that flew about the countryside like living torches, preying on human beings.

Some of the lizards found today in Asia, Africa, and South America are known as dragons. One of them, the *flying lizard,* is less than a foot long, most of its body being tail. On its sides are extensions of skin-covered ribs which act as wings to help support it as it jumps from one branch or one tree to another.

A STUDY IN GRACE AND BEAUTY
The swift dragon fly rests its gauzy wings.

THE FIERY MONSTER OF MYTHS
The dragon has long been a favorite figure in the tales of heroes and knights. It has breathed fire and terror into many an old folk tale.

DRAGON FLY. If there is such a thing as poetry of motion, surely it is exhibited in the flight of the dragon fly. The composer, Ethelbert Nevin, has made it the theme of one of his most charming compositions. The strong, narrow wings and slender body of this insect make it the absolute master of flight. It can poise almost without motion in the air, fly in a series of rapid zigzags, or



Courtesy U. S. Dept. of Agriculture

POOR DRAINAGE WOULD MAKE THIS FERTILE VALLEY BARREN

The great fear of the farmer is the ever-present worry that his land will become less fertile and consequently less productive. Since seeds will not grow in wet, marshy soil, good drainage is vitally necessary for a productive farm.

attain great speed on a straightaway. The collector who has tried to capture dragon flies can testify to their skill in dodging. Almost the only way in which some of the larger kinds can be secured is by the use of a sling shot loaded with fine sand or shot.

These insects are also called *devil's darning needles, mule killers, snake doctors, mosquito hawks,* and many other names of local application. They are perfectly harmless creatures. They live near the water and for food capture smaller insects, chiefly mosquitoes and flies caught in flight.

The young nymphs develop in the water and are very unlike the adults. They may usually be found on or in the mud on the bottoms of ponds, and their most striking feature is the lower part of the mouth, or lower lip. This lip is elongated and hinged, and the outer end is usually cup-shaped and fits up over the lower part of the head like a mask or a nose bag. It is used to scoop up small animals upon which the insect feeds. These curious nymphs have the breathing organs inside the lower end of the intestine. Water is drawn in, the air is used, and then the water is expelled with such force that it serves as a means of locomotion.

Dragon-fly nymphs are among the easiest of aquatic insects to rear in an aquarium, where the feeding habits and the strange breathing and swimming apparatus can be observed at leisure by the interested student. Good specimens of the larger adult dragon flies can best be secured by collecting the nymphs and allowing them to transform in captivity.

DRAIN'AGE. On a low, marshy plot of ground lives a farmer, struggling to gain a living from the soggy earth. His cows and horses find little grass to eat on the wet pastures. His turkeys die, for they cannot endure damp ground. Seed rots in the pools of rainwater that never dry up, and crops mildew and fail.

Yet the farmer's soil is black and fertile. To make it rich and productive, he need only drain it. When he digs drainage ditches and installs underground pipes to carry the excess water away, his fields become productive and his harvests rich.

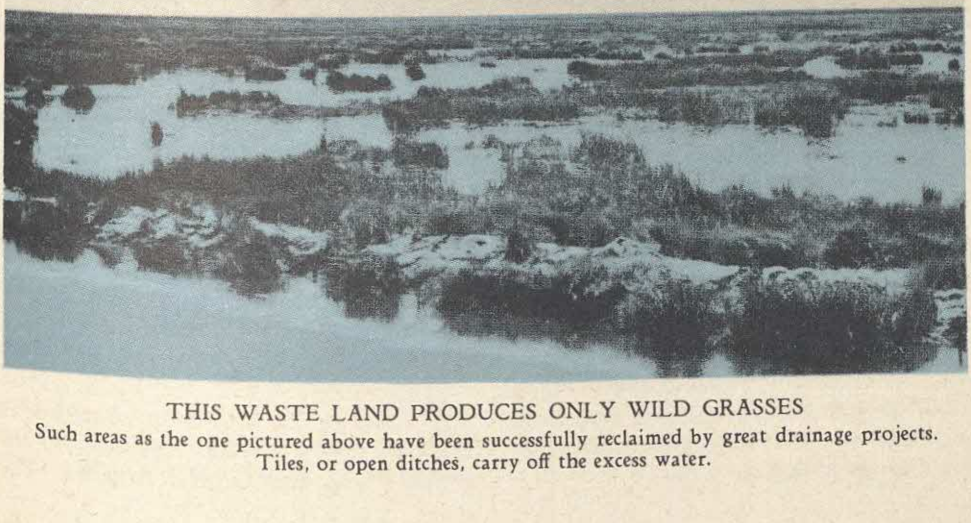
Much of the cultivated area of the United States and Canada is so lacking in drainage that crop production is greatly decreased. In every region it is the level land which is most in need of drainage, because less water runs off flat land than off rolling land. Almost the only rolling land that is too wet is the kind that is on certain seepy slopes where the water comes to the surface.

Marked benefits follow the draining of wet land. One important benefit is the elimination of mosquitoes which carry the malaria germ. With malaria under control, one of the disadvantages of living in low lands is removed. Where land under cultivation is drained, the growing season is extended because the land dries out and warms more quickly in the spring. Besides, the roots of plants go deeper into the soil early in the growing season. Instead of available supplies of water being lessened, as might be supposed, the deeper root penetration allows plants to obtain more water late in the growing season when water is most needed. Proper drainage improves all the conditions which make soil productive.

Improved agricultural land still in need of drainage can be developed best by the use of tile drains, together with enough open ditches to carry the water from the tiles. On lands where tiles are used, the open drainage channels into which they empty should be given good care. The channels should be kept straight, and the walls should be so sloped that they will not cave in during floods. A tile drain is a series of burned clay or concrete pipes of short lengths, laid end to end at depths of from two to four feet. The water enters at the joints between the tiles. Tile drains are much more satisfactory than are open drains because they are permanent and need little attention. Moreover, they drain the land more thoroughly than do open drains.

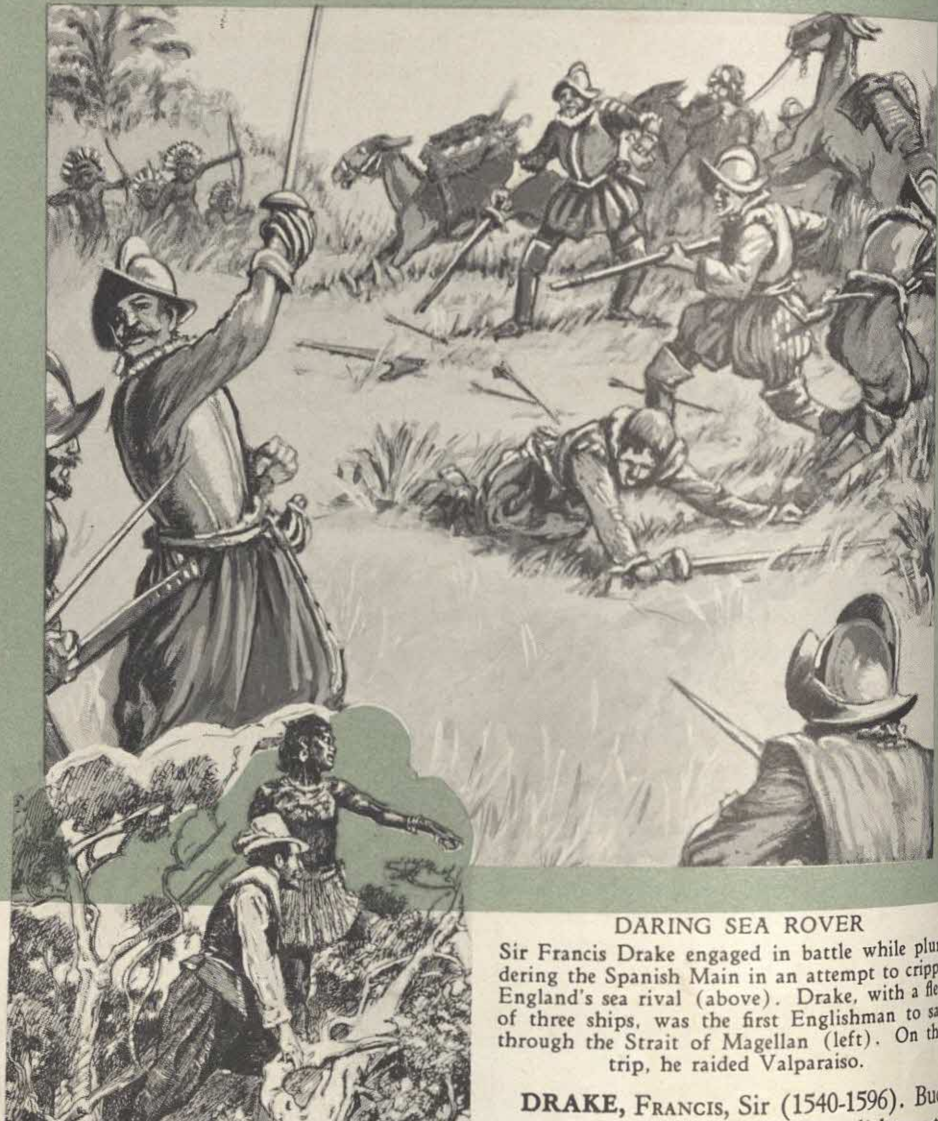
Swamp land as well as tilled land requires drainage. Land that is swampy is usually so because it is lower than the land about it. It is, therefore, difficult to drain, for it is not easy to secure an outlet for the drainage system. Drainage for such land is also expensive, for it requires the digging of large drainage ditches, or canals, often many miles long. Where swamps are located along a stream, it is necessary to build levees to protect the land from overflow.

The usual method of draining a swamp is to dig one or more main canals through



THIS WASTE LAND PRODUCES ONLY WILD GRASSES

Such areas as the one pictured above have been successfully reclaimed by great drainage projects. Tiles, or open ditches, carry off the excess water.



DARING SEA ROVER
Sir Francis Drake engaged in battle while plundering the Spanish Main in an attempt to cripple England's sea rival (above). Drake, with a fleet of three ships, was the first Englishman to sail through the Strait of Magellan (left). On this trip, he raided Valparaiso.

the lower levels, carrying the water to the most convenient outlet. Then smaller canals, or ditches, are dug, which drain into the main canals. If the subsoil is clayish and compact, however, it is sometimes necessary to install tile drains which empty into the open ditches.

DRAKE, Francis, Sir (1540-1596). Buccaneer and adventurer, first Englishman to sail around the world, hero in the defeat of the Spanish Armada, Sir Francis Drake was a colorful figure of the days of galleons and pirates and buried treasure. When a boy, he left his home in Devonshire and was apprenticed to the captain of a coastal vessel.

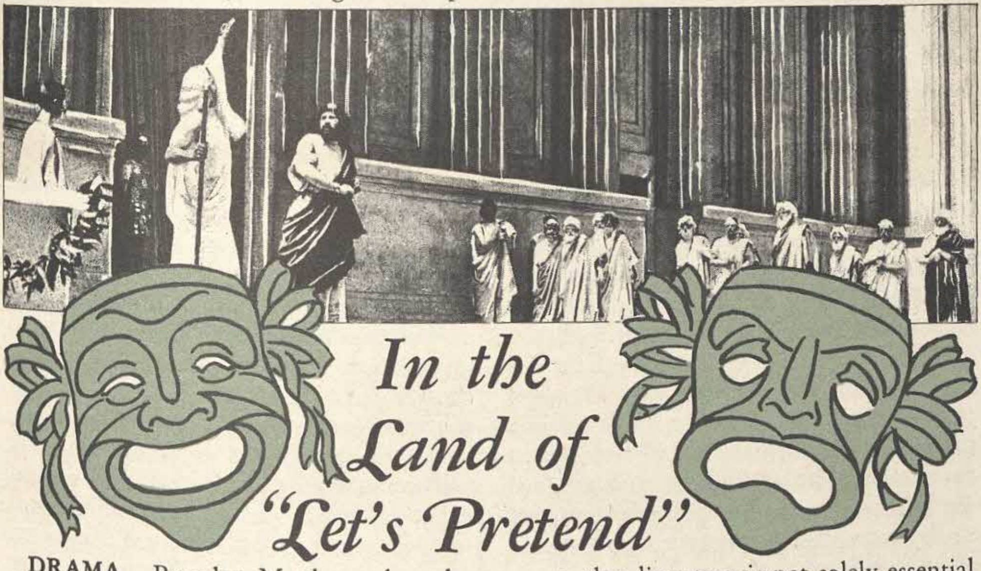
To revenge the seizure of his slave-trading vessel by the Spaniards, he set out in 1572 on a plundering expedition to the West Indies and Central America. The sacking of a town and the seizure of a Spanish galleon yielded great treasure. Drake then returned to England, and commanded the English sea forces in the wars with Ireland.

In 1577, having secured the secret approval of Queen Elizabeth, Drake sailed with five ships to raid the Spanish Main. Crossing the Atlantic, the fleet reached the South American mainland, where two vessels, being unseaworthy, were abandoned. Severe storms in the Magellan Strait caused the loss of one ship and the return to England of another. Drake's own ship, the *Golden Hind,* sailed on alone into the Pacific. He plundered the coasts of Chile and Peru, captured a Spanish treasure ship, and sailed along the coast of North America in search of a waterway back to the Atlantic Ocean.

In a harbor near the site of San Francisco, he refitted his ship, and claimed the land an English possession, naming it New Albion. Then he sailed across the Pacific, stopping at some of the islands, including the Philippines, Celebes, and Java. After crossing the Indian Ocean and rounding the Cape of Good Hope, Drake arrived in Plymouth, England, September 26, 1580, three years after his departure.

Despite Spain's protests against Drake's plundering, Queen Elizabeth finally recognized Drake's exploits and knighted him. Five years later, he again raided the Spanish colonies of the West Indies, the Florida coast, and the Caribbean; in 1587 he committed his boldest stroke—the destruction of a Spanish fleet assembled in the harbor of Cadiz.

In 1588 Spain, in reprisal, sent her "Invincible Armada" to attack England, but the utter destruction of the Spanish fleet by the British and by storms definitely established England as the "Mistress of the Seas" (see ARMADA). In 1595 Drake took part in an unsuccessful plundering expedition against the West Indies with his kinsman, Sir John Hawkins. Later in the year, Drake died and was buried in the southern sea, where his name was so hated.



In the Land of "Let's Pretend"

DRAMA. Brander Matthews has defined drama as "a story in dialogue shown in action before an audience." Strictly speaking, drama does not lie wholly within the limits of literature. Pantomime, which does not use words in its presentation, proves that literature is not solely essential to its success. In general, however, drama is classified as one of the forms of literature, along with the lyric, the epic, the novel, the essay, and the short story.

The two main divisions of the drama are

tragedy and comedy. Tragedy usually treats the more serious aspects of life, whereas comedy depicts the lighter moods of its characters and ends happily for all. There are dramas, however, that strictly are neither comedy nor tragedy but present a combination of humor and pathos. From time out of memory, the world has looked to the drama for comments upon life, and the greatest minds of all ages have attempted to portray the soul's deepest conflicts and to hold up to ridicule the follies of mankind. We cannot but be impressed by the universality of the drama, by its persistence as an element in culture, and by the magnitude of its influence.

Greek Drama. Greek drama had its origin in the songs chanted by the choruses who impersonated the followers of Dionysus in the festivals held in his honor. From the men who, clad in goatskins, performed these choruses, we get the word *tragedy,* taken from a Greek word meaning *goat.* In time, the persons who were to form the choruses were selected. The poet Arion led his chorus of fifty. A half century later, Thespis came forward as a reciter of verses. Aeschylus introduced two persons, both, like the reciter, detached from the chorus. By this change, Aeschylus altered the whole character of the lyric tragedy and created a new type of drama.

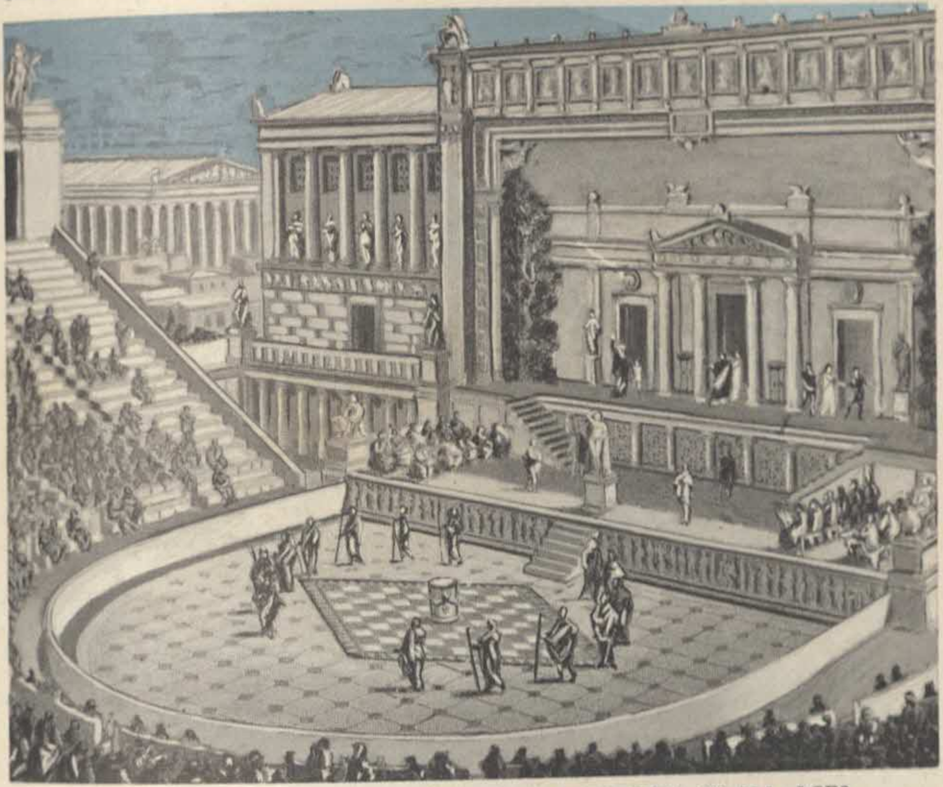
Much is made of the three unities in the discussion of Attic tragedy. These unities are of *action, time,* and *place.* Unity of action demands that the incidents of the play be restricted to those concerned with the main action. Unity of time confines the events to those of a single day. Unity of place confines the action to a single locality. Despite these restrictions, Greek drama possessed real human interest and attained the height of poetic style. Greek tragedy was not merely entertainment, but had a serious religious function. Its motive, as defined by Aristotle in his *Poetics,* was to purify the passions of fear and pity through the exercise of them.

Greek comedy is commonly divided into these periods: the Old, the Middle, and the New Comedy. Aristophanes best exemplifies the Old Comedy, in which the leading men of his day were scathingly ridiculed. The Middle Comedy played up the follies of classes rather than of individuals. The New Comedy sought to develop types of characters, such as the gullible old man, the dissipated son, and the impudent servant. Many of these types are common in plays of today.

It is said that Greek literature is the one entirely original literature of Europe. With no models before their eyes to provoke imitation, along with almost every other form of literature the Greeks created the drama in a great variety of forms, and these forms have served to inspire dramatic writers of all ages.

Roman Drama. Roman drama is known to us chiefly through the work of three writers—Plautus and Terence, who wrote comedies; and Seneca, who wrote tragedies. Plautus has a degree of vigor and broad jocularity, while Terence is more refined and delicate in his wit and characterization. Throughout the works of both we find echoes of the New Comedy. Seneca is credited with writing ten rhetorical dramas, though they are certainly not all his. They were written to rival the writings of Euripides and other Greek tragic writers, and probably were not intended to be acted. They dealt with the most sensational and bloody stories of Greek mythology. The tragedies of Seneca became the main classical influence upon modern tragedy.

Medieval Drama. In the Middle Ages, we find a new dramatic form which evolved out of the ritual of the Church. By the thirteenth century, rude dramas had developed about the sepulcher (Easter) and the manger (Christmas). Still a third group of plays developed, dealing with scenes from the Old Testament, supposed to prophesy the coming of Messiah. A later development of the drama is shown when plays were presented in the native language, instead of Latin, by guilds outside the Church. The guilds introduced realistic incidents and comedy scenes. Emphasis



THE GREEK THEATER HAS INSPIRED DRAMATISTS OF ALL AGES

In magnificent open-air theaters, the Greeks presented classic dramas, many of which are still popular. Using no elaborate scenery, Greek comedy created living characters, types which we know today. Greek tragedy often had a religious significance.

was placed on the development of such characters as Herod, Pilate, and Noah's wife.

During the fourteenth and fifteenth centuries, hundreds of plays were produced, of which four fairly complete cycles are in existence. They were usually presented on Corpus Christi Day, and were elaborately staged. The different cycles covered dramatic events in the Bible from the Creation to the Day of Doom. These plays were originally called "mystery plays." They are to be distinguished from the "miracles," which were dramatic adaptations of a saint's life with the intercession of the Virgin in behalf of the suffering saint. Gradually the plots became more ingenious and more directed to a worldly purpose. They sought to depict certain moral conflicts and became known as "morality plays."

Much use was made of allegories during the fifteenth and sixteenth centuries. Out of these beginnings, varied by occasional secular tendencies, the modern drama gave promise of development when the Renaissance came with renewed interest in the classics.

English Drama. The next step in the development of modern drama was taken by John Heywood (born about 1497) in his creation of the interlude. In his realistic characterization of *The Palmer and the Peddler* and *The Pardoner and Poticary,* we have character firmly established as one of the main objectives of drama. It remained for the first writers of comedy, properly so-called, to bring plot to a similar

MOLIERE WAS THE GENIUS OF FRENCH COMEDY
The satirical, clever comedy of manners reached a high point of perfection in the work of this great master, shown here rehearsing his troupe in a new play.

importance. *Ralph Royster Doyster,* by Nicholas Udall, is generally accounted the first English comedy.

The next play to attain the classification of real comedy was *Gammer Gurton's Needle,* probably written by William Stevenson, although the authorship is not definitely established. With these two notable plays English comedy was well on its way.

The first play to gain the name of English tragedy was *Gorboduc*. Probably the most distinctive feature of *Gorboduc* is that it was written in blank verse, which was destined to be a favorite form of expression in dramatic literature.

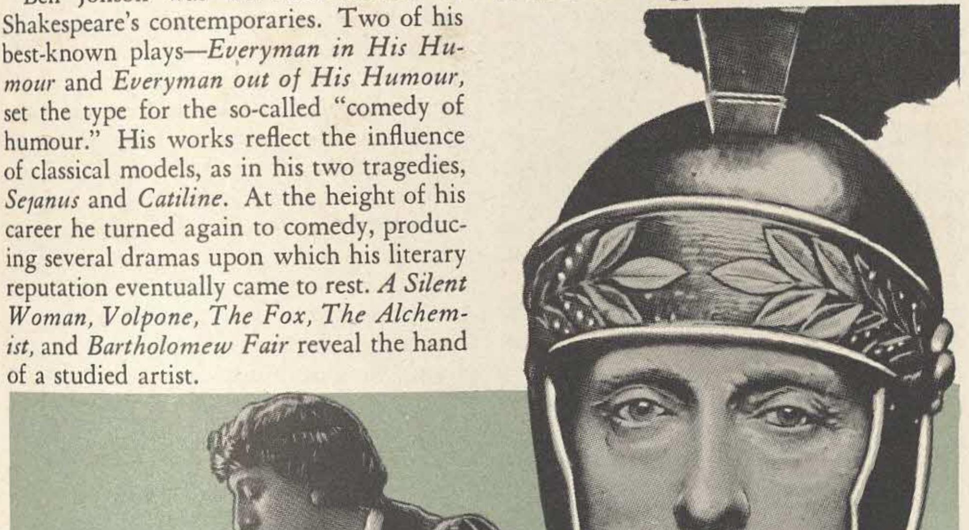
From this time, dramatic production was rapid. The mere mention of Kyd, Lodge, Lyly, Peele, and Greene serves to remind us of the rare talent that was devoting itself to drama. Comedy had outdistanced tragedy in England. Before the time of Kyd and Marlowe, no great tragedies were produced. But these two masters of English tragedy treated the serious aspects of life with such originality and skill that tragedy soon became as popular as the lighter and more entertaining plays had been.

Marlowe, the greatest of Shakespeare's predecessors, was a poet of extraordinary ability. His plays *Tamburlaine, Dr. Faustus, The Jew of Malta,* and *Edward II* were evidences that the dramatic art was approaching its zenith. To far greater degree than any of his predecessors or contemporaries, Marlowe influenced Shakespeare. How much Shakespeare owed to him can be understood only by studying tragedy before the time of Marlowe.

With due credit given to all the predecessors of Shakespeare, the more we study his famous works, the more we are convinced that without him English dramatic art would miss its crowning triumph. Shakespeare is almost universally regarded as the greatest dramatic genius of all time. When we seek to understand his deep insight into human nature, the breadth of his interests, his power to create dramatic situations, and his command of poetic expression, we are overwhelmed. That one man should possess the finest traits of the greatest masters of dramatic literature is truly awe-inspiring.

Ben Jonson was the most famous of Shakespeare's contemporaries. Two of his best-known plays—*Everyman in His Humour* and *Everyman out of His Humour,* set the type for the so-called "comedy of humour." His works reflect the influence of classical models, as in his two tragedies, *Sejanus* and *Catiline*. At the height of his career he turned again to comedy, producing several dramas upon which his literary reputation eventually came to rest. *A Silent Woman, Volpone, The Fox, The Alchemist,* and *Bartholomew Fair* reveal the hand of a studied artist.

Other contemporaries were Beaumont and Fletcher, who collaborated in producing romantic dramas which were popular in their day and led to the creation of the "heroic drama." Other distinguished writers of the Elizabethan drama were Ford, Massinger, Dekker, Webster, Middleton, and Shirley. While their plays reveal dramatic power now and then, there is little in them that suggests the masterful touch



SHAKESPEARE'S CLASSICS LIVE AS THE WORLD'S FINEST PLAYS

Most of the brightest names of the theater were borne by Shakespearean players. Below are Mrs. Patrick Campbell and Forbes-Robertson as Romeo and Juliet; and right, in a sterner rôle, is the latter as Caesar. Shakespeare's insight into human emotions, his knowledge of people, and his ability to combine emotion and characterization in powerful dramatic situations have given his plays an enduring realism.

of Shakespeare, and in one way or another they reveal a decline in dramatic genius.

During the Commonwealth, the Puritans prohibited all kinds of plays. Theaters were closed for thirteen years. With Charles II the drama reappeared, but the Restoration drama reflected contemporary life. The principal writers of this period were Dryden, Otway, Lee, Wycherley, Shadwell, and Farquhar.

In the eighteenth century, the English literary drama was greatly influenced by the French standards and models. Steele's sentimental plays remind us of the "tearful comedy" of France. It is a great relief to turn from the sentimental plays of Steele to the English comedy of manners as presented by Goldsmith in *She Stoops to Conquer,* and by Sheridan in *The Rivals* and *The School for Scandal.*

With the advent of the Romantic movement, the influence of pseudo-classicism began to wane. Wordsworth, Coleridge, Byron, Keats, and Shelley attracted attention to romantic literature of another type. English writers of the nineteenth century were too indifferent to theatrical technique to produce effective plays. Tennyson, Browning, Arnold, and Swinburne all wrote dramas, but they were of the "closet" type, which are better when read than when staged.

The more prominent of the modern English playwrights are Pinero, Jones, Wilde, Shaw, Galsworthy, and Barrie. These writers are widely known through their published plays, many of which are still being acted on the American as well as the English stage. The seriousness with which these brilliant writers delineate characters and social customs of the present day suggests a real revival of dramatic activity, particularly in the "drama of ideas."

Other European Drama. In France the medieval drama survived much longer than it did in England. Throughout the fifteenth and sixteenth centuries, mystery plays continued to be acted in France. The influence of the Renaissance spread from Italy into France in the reign of Francis I. The effect of this revival in France was to stimulate scholars to translate the classics into the vernacular and to imitate Latin plays.

The outstanding writer of tragedy was Corneille, called the creator of French tragedy. His first play, *The Cid,* did not adhere to the three unities, for which he was censured by the French Academy. Thereafter, he accepted the classical restrictions, but was apparently handicapped by them. His plays have such literary merit that they may be read with pleasure and are so dramatic that only when they are played does one become fully aware of their power.

Another of the more prominent French dramatists was Racine. He excelled in the analysis of passion; love is the dominant motive in his plays. He followed the Greeks in simplicity of plot and in restraint and unity. But it is in Molière that French drama found its highest expression. Unlike Corneille, Molière sought to portray the life about him.

In the nineteenth century, the drama of France was more productive than that of any other country. The chief writers of this century are Alfred de Vigny, Alfred de Musset, Scribe, and George Sand. The elder Dumas and Victor Hugo were leaders of the Romantic movement. A host of new writers came forth and became known throughout Europe and America, such as Maurice Maeterlinck, Paul Hervieu, Maurice Donnay, and Eugène Brieux. Their works give evidence that the modern drama is mainly interested in ideas.

The German drama is of later birth than any we have mentioned. The Germans long contented themselves with translations and adaptations from the French until the later part of the eighteenth century, when Lessing took the lead in the attack on the prevailing French conventions. His *Miss Sara Sampson,* his comedy *Minna von Barnhelm,* and his later tragedies opened a new era for German drama.

Goethe, his great successor, is without doubt one of the world's foremost geniuses, but he was poet and novelist rather than dramatist. Schiller, his contemporary, was expressly a dramatic poet. His *Wilhelm Tell* and *Maria Stuart* rank high as romantic dramas. Goethe and Schiller, like Lessing, turned to Shakespeare for inspiration. The plays of Hermann Sudermann and Gerhart Hauptmann represent later activity in German drama.

Ibsen, Björnson, and Strindberg are the outstanding figures in Scandinavian drama. As a dramatist, Ibsen owes much to the French playwrights, from whom he learned valuable lessons in dramatic technique, but he eventually evolved a method all his own. Few writers have gained the instant international recognition accorded Ibsen. The secret of his widespread popularity lies in the fearless manner in which he attacked the major social problems of his generation. He was first and last a dramatist; his plays both "read" and "act." He delights in arousing the emotions of his audience. Such plays as *Peer Gynt, The Pillars of Society, A Doll's House, Ghosts, An Enemy of the People,* and *Rosmersholm* stand out as dramatic masterpieces.

The contemporaries and followers of Ibsen and Björnson are naturally overshadowed by their acknowledged masters, but such men as Gunner Heiberg, Vetle Visle, Gabriel Finne, Anders Stilloff, and Knut Hamsun have all made interesting contributions to the Scandinavian drama.

American Drama. Owing to a common language, it is difficult to separate the drama of the United States from that of Great Britain. America has long had a theater of importance, but not a drama. Plays that achieve great success are usually read and acted in both countries. Not until the later part of the nineteenth century, did America produce plays that merit real distinction.

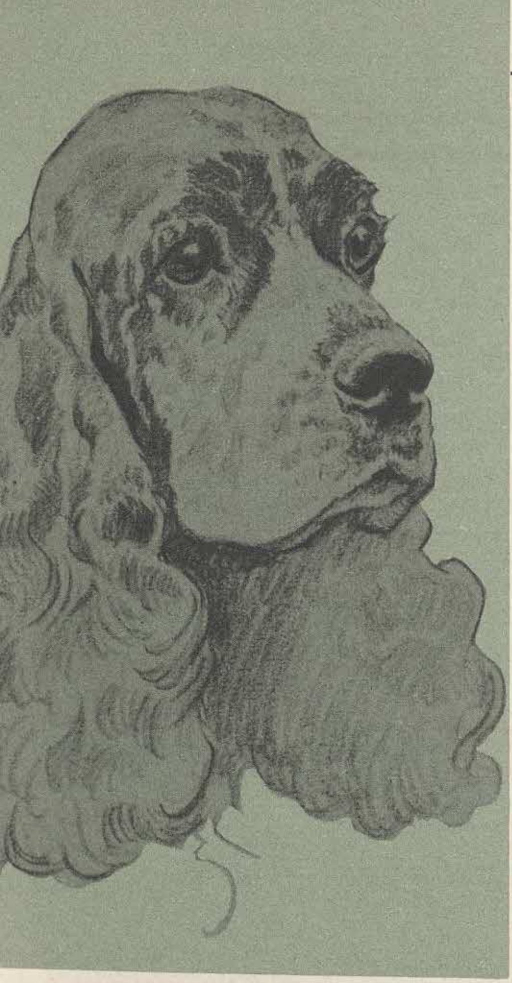
In 1886 Denman Thompson produced *Old Homestead,* which is the first American play to hold the stage over a period of years. It was typically American in its theme and methods of characterization. *Shore Acres,* by James A. Herne, was produced in 1892. It resembled *Old Homestead* in many ways. About this time appeared a delightful comedy by Bronson Howard entitled *The Henrietta.* Plays remarkable for their local color were produced by Augustus M. Thomas. They are *Alabama, In Mizzoura,* and *Arizona.* Thomas was also the author of *The Witching Hour* and *As a Man Thinks.*

William Gillette gained instant recognition in his dramatization of A. Conan Doyle's *Sherlock Holmes.* He was also the author of *Secret Service* and of the entertaining comedy *The Private Secretary.* Probably the most prolific of American dramatists was Clyde Fitch, author of *The Climbers, The Truth, The Girl with the Green Eyes,* and other social dramas. *Paid in Full,* by Eugene Walter, *The Heart of Maryland* and *The Girl of the Golden West,* by David Belasco, and *The Great Divide,* by William Vaughn Moody, are among the best American plays.

Noted dramatists of the twentieth century include: Maxwell Anderson *(Elizabeth the Queen);* Philip Barry *(Holiday);* S. N. Behrman *(No Time for Comedy);* Marc Connelly *(The Green Pastures);* Rachel Crothers *(Susan and God);* Sidney Howard *(They Knew What They Wanted);* Clifford Odets *(Golden Boy);* Eugene O'Neill *(Ah, Wilderness);* Elmer Rice *(Street Scene);* Robert Sherwood *(Abe Lincoln in Illinois).*

Consult the following titles:

Annunzio, Gabriele d'
Aristophanes
Barrie, James, Sir
Comedy
Comic Opera
Dryden, John
Dumas, Alexander
Euripides
Galsworthy, John
Gilbert, William S.
Goethe, Johann von
Goldsmith, Oliver
Hamlet
Hauptmann, Gerhart
Ibsen, Henrik
Jonson, Ben
Macbeth
Maeterlinck, Maurice
Marlowe, Christopher
Masque
Melodrama
Miracle Play
Molière
Morality Plays
Mystery
O'Neill, Eugene
Opera
Passion Play
Schiller, Johann F.
Shakespeare, William
Shaw, George B.
Sheridan, Richard B.
Sophocles
Theater
Tragedy
Yeats, William B.



The Pencil Speaks

Gaines Dog Research Center

DRAW'ING. When a child picks up a pencil and scrawls meaningless lines on a piece of paper, he is giving vent to an urge to express himself. Such a desire is natural to every person, for drawing is one of the most fundamental of all expressions. Man, in his primitive days, drew lines to express his thoughts and feelings, and on the walls of ancient caves, where once he lived, are found drawings of buffalo, deer, birds, trees, and hunters, some of them excellent in form and design.

Most authorities say that, just as a child may be able to draw a rough, crude outline of a cat or a dog before he can write, man could express himself in pictures before he had a written language. Man's desire to draw is responsible for our modern alphabet, for it is from the ancient Egyptian hieroglyphics, which were pictures, that the Phoenicians adopted the symbols that later became the letters we know today.

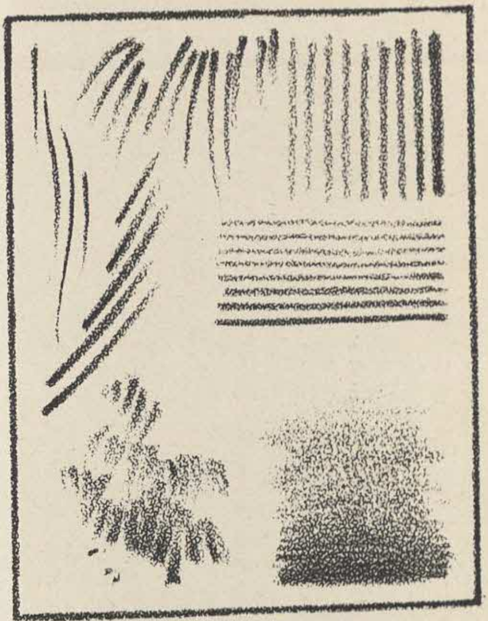
A Universal Language. Like music, drawing needs no translation to be understood by people of any country. A Frenchman may draw a picture of a horse, and it is a horse to Americans, Russians, Italians, or any other people. The study of drawing is immensely useful to everyone, no matter what his work may be. It leads to an appreciation of nature by allowing the person to gain knowledge and inspiration first hand; it makes for a keener sense of observation; stimulates the imagination; develops creative instinct; forms the basis for scientific study; creates an outlet for individual expression. Drawing teaches muscular control and co-ordination between the eyes and the hands, just as baseball does, and lays the groundwork for application and appreciation of art. For the mechanic, the architect, the carpenter, the designer, or the businessman it is indispensable, for it is true that one picture or design sometimes can tell a story better than ten thousand words.

Learning to Draw. For all drawing, whether beginning or advanced, there are certain rules which should be followed. The best material for beginners is a large, blunt, soft pencil or crayon, and paper. The beginning student should remember that there are several types of lines he can draw: *unaccented* lines, which have very little expression or character of themselves, and *accented* lines, which can breathe life into a drawing.

Trees offer ideal subjects for the beginner to draw, because of the endless variety of forms they take. The student should not attempt to draw in outline, but should start by massing in the simple tree form and then adding the trunk and ground. As the student develops, he will want to study the branch formation of various trees, drawing first the tree skeleton and then adding the foliage. In this way he will begin to distinguish between such trees as the oak, maple, or cedar, and get an insight into the marvels of nature.

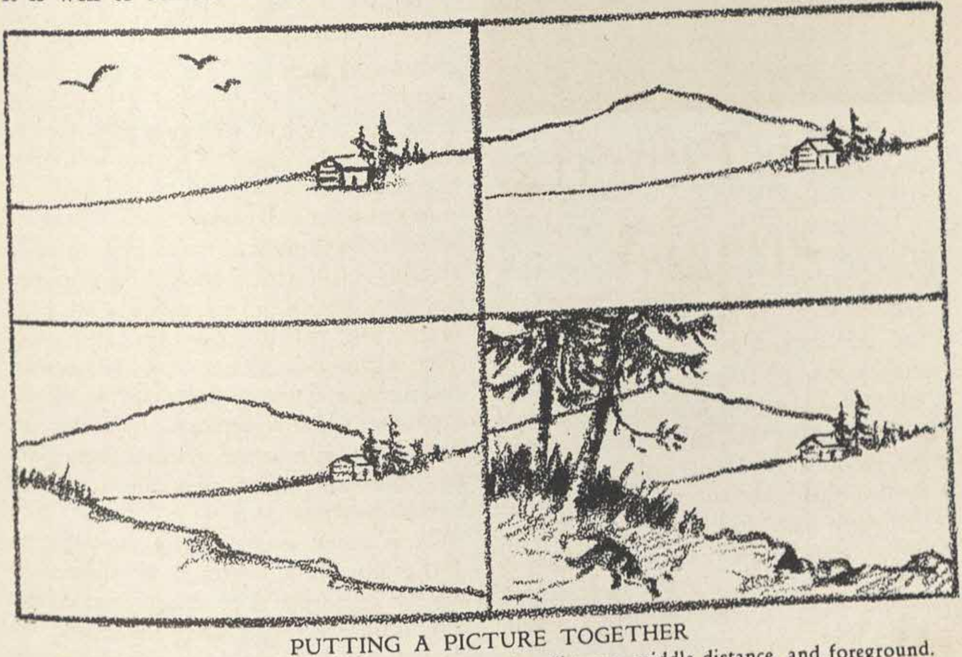
Among the first things to learn is the placement of objects in a drawing. The general rule that must be followed in placement is that objects that appear far away should be smaller and placed higher in the picture, while nearer objects are larger and placed lower. Perspective, which gives the impression of distance and relative size, is most easily obtained through the aid of a line known as the horizon line, or "eye level." This is the line where the sky and earth appear to meet. For example, if a number of balls are drawn, each of their tops touching a straight line, the smaller ones will appear farther away than the larger ones.

Landscape drawing gives the student an excellent opportunity to develop his skill. It is well to remember that a landscape



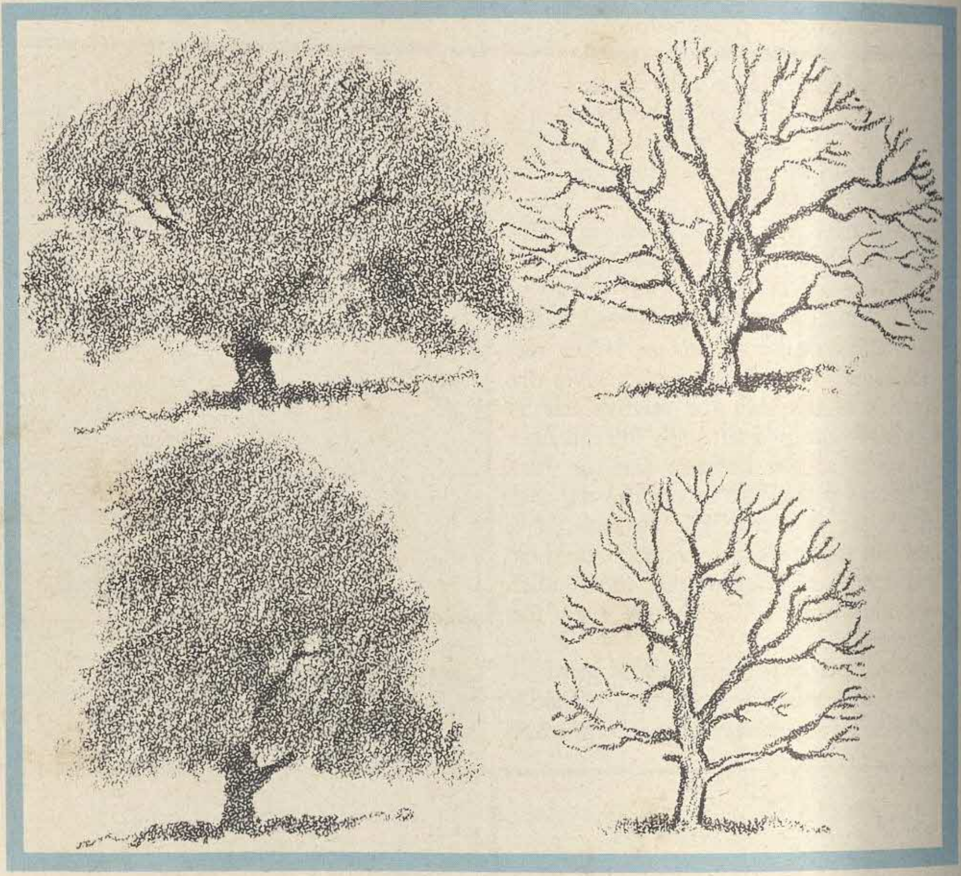
LINES THAT LIVE

Lines are either accented or unaccented. This is the secret of character in drawing. Accent means variation in pressure, and with it a simple line is given true expression.



PUTTING A PICTURE TOGETHER

A landscape is usually composed of four parts—sky, distance, middle distance, and foreground. These four sketches show how, by adding details, a simple composition can be developed. The large tree in the foreground helps give the effect of depth to the picture.



AS THE TREE GROWS, SO IT IS DRAWN

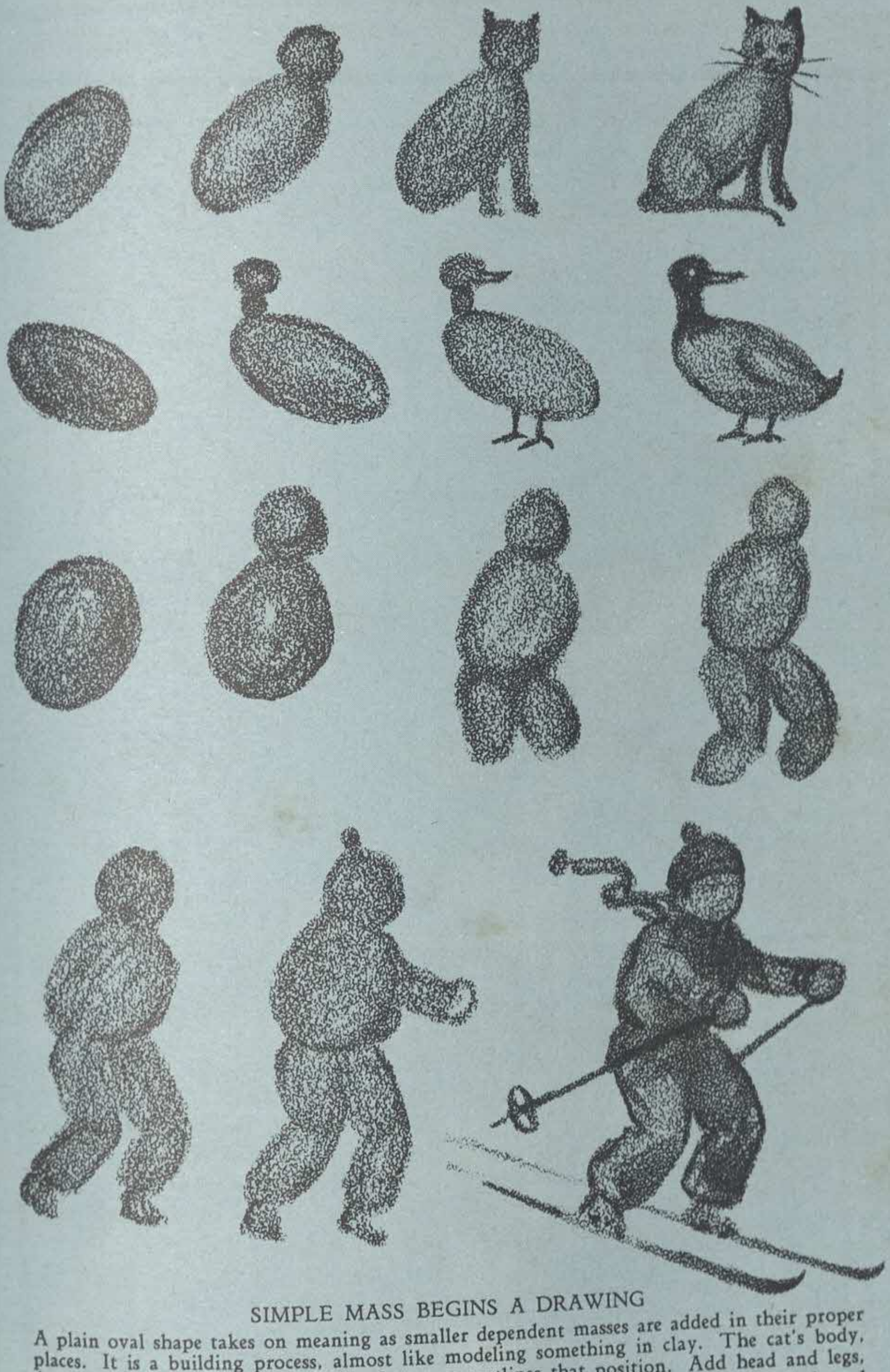
A full-leafed tree should first be drawn in simple mass. But as the student progresses, he finds that the tree has a "skeleton" of branches, which determines its shape (right). Soon he learns to know the branches before drawing the tree.

may have four parts: the *sky, distance, middle distance,* and *foreground;* but it does not necessarily have to possess all four. It may have the sky, distance, and middle distance; the sky, middle distance, and foreground, or just the sky and foreground.

To draw figures, the most essential things to remember are the meanings of different lines and what they express. Vertical lines, for instance, give the impression of stillness or lack of movement. Oblique lines indicate motion, and a combination of vertical and oblique lines gives movement to a still figure. Parallel lines represent orderliness.

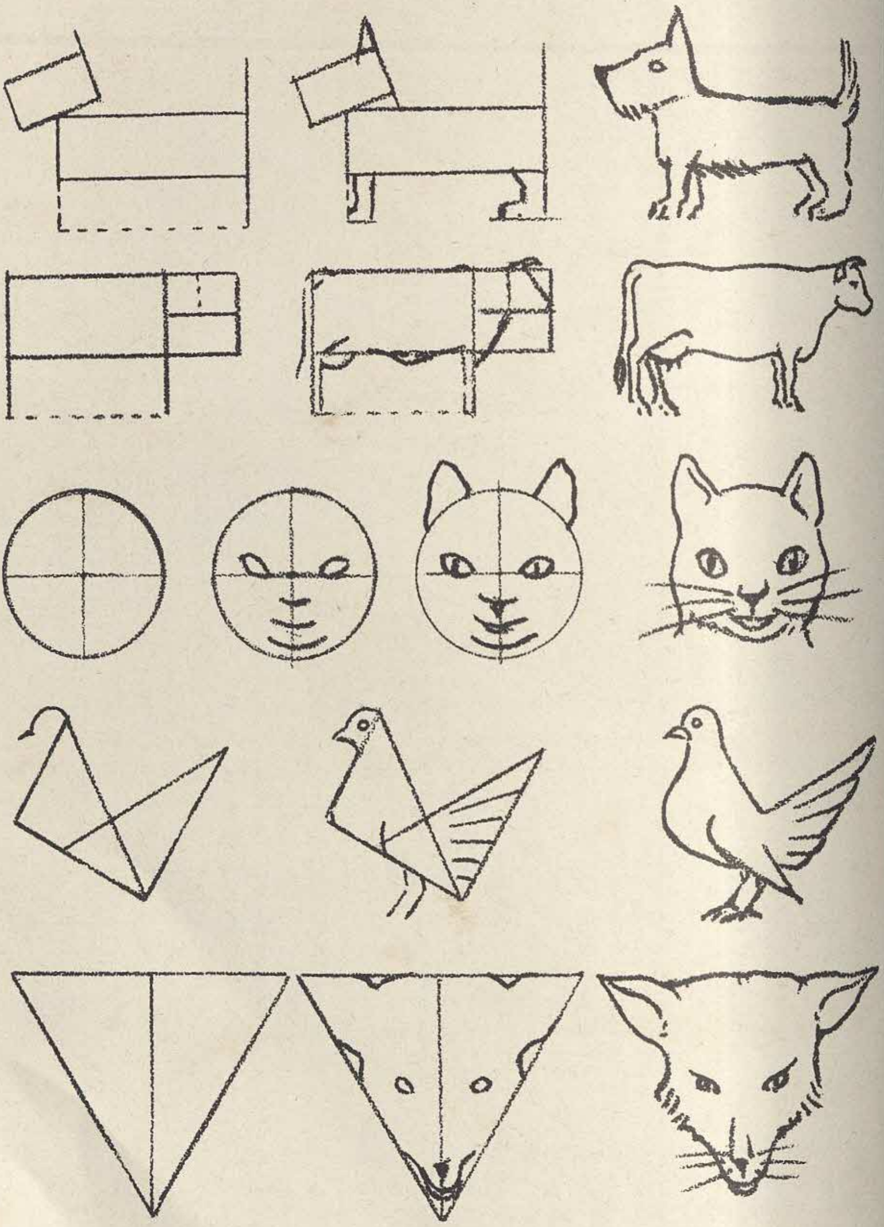
Advanced Drawing. When the student of drawing has mastered the use of lines, placement, and perspective, and has studied the use of these in landscapes, simple objects, and figures, he may graduate to the study of the human figure. A simple rule to remember for those beginning this study is to make the body, the thigh, and the legs of equal length. The foot is half the length of the lower leg, and the arm reaches to the middle of the thigh. The head, of course, is the most interesting part of the human figure to draw. One must first learn the position of each part of the head, and study the oval shape and its placing.

Merely drawing a figure accurately is not enough, however. To put expression



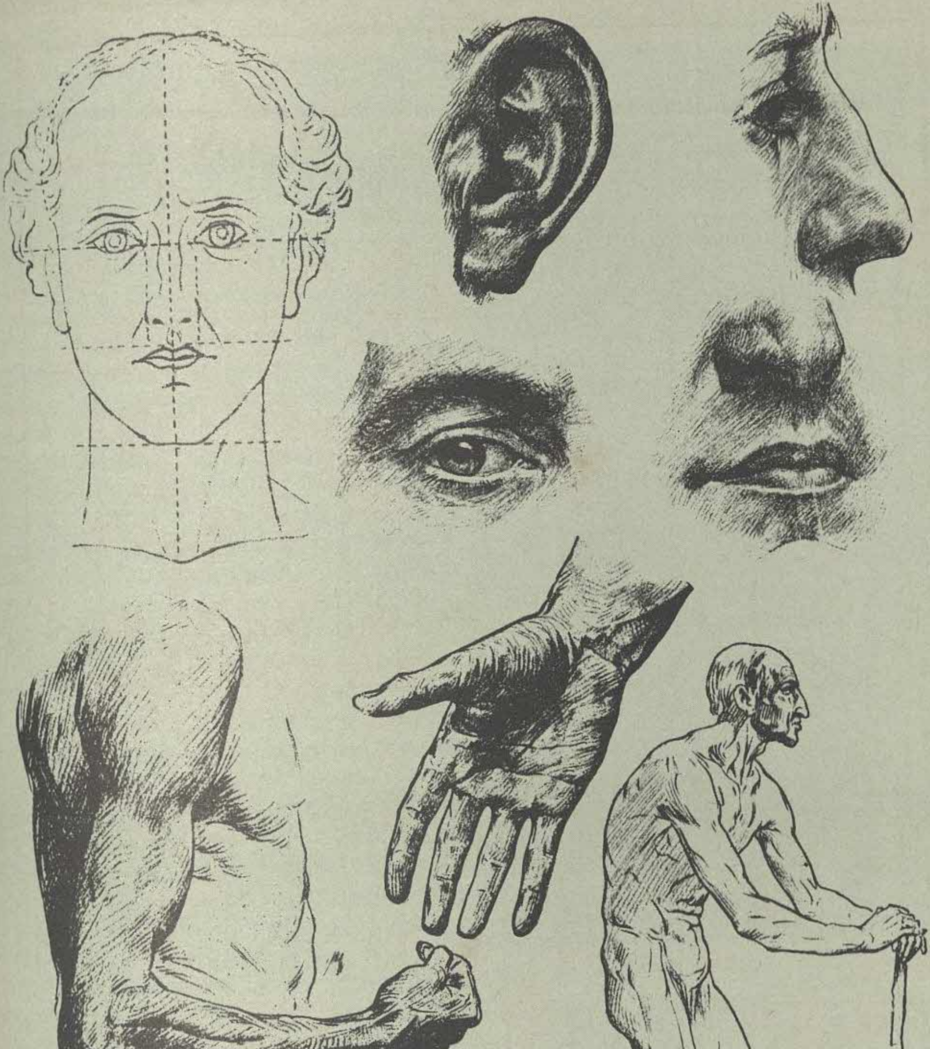
SIMPLE MASS BEGINS A DRAWING

A plain oval shape takes on meaning as smaller dependent masses are added in their proper places. It is a building process, almost like modeling something in clay. The cat's body, for instance, is at an angle, and the first mass outlines that position. Add head and legs, and only a few lines are needed to complete the picture. The same holds for duck and boy. The original mass positions give the picture its lifelike action.



SQUARES, CIRCLES, TRIANGLES, BUILD LIVING PICTURES

Every object we draw has a basic form. By starting with such a form, the student of drawing can make an endless variety of interesting sketches. This method is a great help in getting proportions correct. The terrier (top) is really just two rectangles. In the second stage he is still the same, but with added detail. Very small changes in the last picture take the stiffness out and put in the Scotty's lifelike appearance. So it is with the cow, the cat, and the pigeon. The face of the fox, simplest of all, fits the basic triangle perfectly, requiring only a few added details.

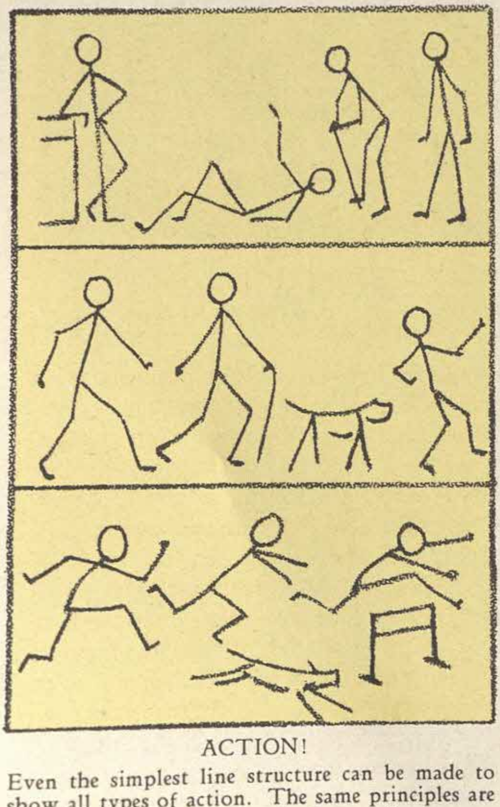


DETAILS MAKE THE MAN

Advanced drawing students build the whole from the parts—and they have to *know* the parts. Variations in proportions in each feature give the face (top) its individuality. The true portrait unites those details as it unites the features. Ears, noses, eyes, mouths—all have such variations, yet adhere to the same general pattern. So must the muscles of the arms, hands, and feet be understood before they can be combined to make the man.

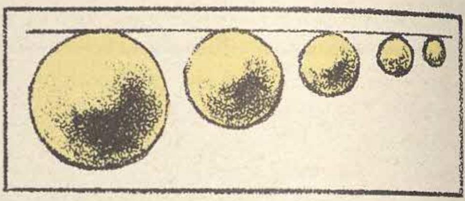
into it is the task of the person who wishes to make his drawing of the human figure more than a mere mechanical operation. Here, again, the understanding of lines is important. Horizontal lines, for example, indicate repose. Pleasure is expressed on the face by expanding lines and predominant curves. For sorrow, the lines are drawn downward, and the eyebrow arches upward at its inner angle. Angular lines are used to express passion. The cartoonist makes use of this simple formula to express every action and emotion.

With the study of drawing also must be included the study of *rhythm,* in order that gracefulness and beauty may be contained in the drawing. Not only must the *form* of objects and figures be correct, according to perspective and placement, but they must be arranged in pleasing groups. Such arrangement is called *composition,* the simplest of which is the triangle.



ACTION!

Even the simplest line structure can be made to show all types of action. The same principles are followed in drawing the human figure.



WHICH IS CLOSER?

Relative size shows *perspective,* or depth.

Other Types of Drawing. Not all drawing is of the type we know as *freehand.* There is also *mechanical drawing,* which necessitates the use of triangles, scale ruler, T-square, compass, dividers, and other instruments. Such drawing is essential to the work of draftsmen, architects, and engineers, who must know the measurements and designs of their creations.

Scientific drawing combines the use of instruments with natural skill, for measurements must be exact, as well as vivid and clear.

DREAMS. Dreams have been a fascinating mystery to mankind from the earliest times. Because of the marvelous things which may happen to us in dreams, it is not surprising that there has always been a tendency to attribute to them something of the supernatural.

The exact nature of our dreams is still a mystery to psychologists, though there are many theories about it. It seems to be well established that the cause of a dream is often something which reaches the brain through one of the senses—a noise, the weight of bedclothes, the presence of undigested food in the stomach. There is also ground for believing that we are dreaming all the time we are asleep, but only remember our dreams when they are particularly intense. The chief dispute is over the substance of our dream thought.

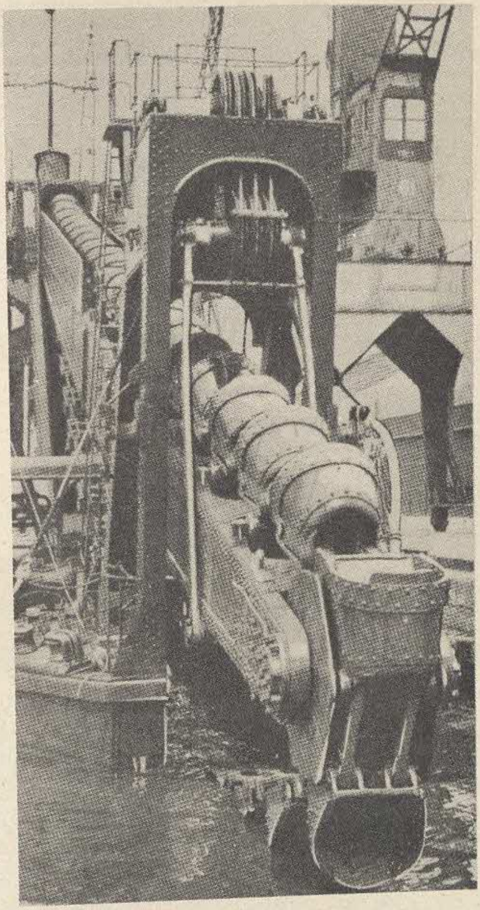
Some theories hold that dreams represent subconscious desires; others, that they result from the mental response to pressing problems. In any case, it is evident that dreams are successions of associated ideas which present themselves freely in sleep but are normally subordinated to the activities of waking hours.

DREDGING, *drej′ing.* Whenever rivers or harbors become so filled with mud or sand that boats are in danger of becoming "grounded," machines are put into service for dredging, that is, removing, these obstructions. Working often forty or fifty feet under water, these mammoth machines are capable of doing work impossible by man power. Thousands of yards of mud and silt must be moved quickly and economically, and in order to operate economically, a dredge must move 50,000 cubic yards of material daily.

Such machines may be either land dredges or floating dredges. Land dredges usually straddle a ditch or sit on one bank, dipping into the water with "clam-shell" buckets, or dragging the bottom of the ditch or river with a great scraper.

Most dredges are of the floating variety. Mounted on barges, the *dipper* dredge, popular in America, looks and operates much like a steam shovel. The dipper picks up about ten cubic yards of mud at a time, emptying it on a barge floated alongside the dredge. Dredges of this kind can reach the bottom of a fifty-foot harbor. A *grapple* dredge, similar to the dipper dredge, reaches vertically into the water and grasps piles of earth and rocks as a boy would reach into a barrel of apples.

Another popular type is the *suction* dredge, often used in muddy rivers and harbors. It mixes the mud and water together, pumping both to the surface through pipes. Rivers and harbors are usually kept cleared out by the Federal government, which controls all navigable waterways.



CLEARING THE CHANNEL
Dredges like this are constantly at work digging up tons of silt to deepen ship channels.

DRED SCOTT DECISION. One of the vital incidents leading to the Civil War was the Dred Scott Decision of the Supreme Court of the United States, handed down in March, 1857. Instead of settling the slavery question, as was hoped, it increased the rising bitterness between the free North and the slave-owning South.

Dred Scott, a Negro slave, was taken by his owner from Missouri to Illinois, a free state, thence to Minnesota, a free territory under the Missouri Compromise, and then back to Missouri, a slave state.

Scott sued for his freedom, claiming that his two-year residence in Illinois and Minnesota made him a free man. The Supreme Court of the United States concurred with the finding of the Missouri Supreme Court, that Scott was not a citizen. It declared that, under American law, a Negro was a chattel, a piece of property, and had no rights or privileges except those the government might choose to give him. The decision that the Missouri Compromise was unconstitutional practically admitted slavery to every territory in the Union. See Missouri Compromise.

Fashion *through the Ages*

DRESS. During the early stages of man's life on this earth, his principal concern was where to find food and how to save himself from being eaten by hungry animals. He did not even worry much about shelter, for he chose warm lands for his home, and there were caves and forests to shield him from sun and rain and wind.

How then, did it come about that man thought of clothing himself? Comfort must have prompted man's first attempts. In a far-off period of geological history, glaciers crept down from the north and covered much of the earth's surface with a sheet of ice. Man, becoming cold in the changed climate, took to wearing hides and furs to keep from freezing. Today, man's clothing is largely determined by the climate in which he lives. In frigid countries warm clothing is necessary to life; and in tropical jungles and deserts white clothing protects man from the blazing sun and biting insects. There are, of course, some exceptions to the rule. Even today, for example, the inhabitants of Tierra del Fuego, at the cold tip of South America, are more lightly clad than are the heavily robed Arabs of the hot desert.

But comfort is no longer the only reason for going about in silks and furs and flannels. Men like to "show off." Primitive peoples tattooed and painted their bodies, wore necklaces of stones and bones, and dressed in bright feathers. Men and women today vie with one another to be first with new fashions, wearing handsome suits and neckties and uniforms, and beautiful gowns that will attract favorable attention and mark them as well dressed. Men buy new shirts because the latest style calls for a collar with points instead of curves; women discard last year's dress because it is two or three inches shorter than this year's fashion.

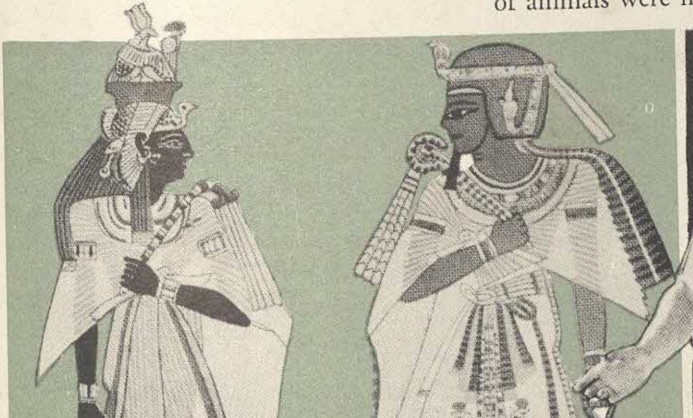
So we wear clothes for comfort, for attractiveness—and also for modesty. Probably the primitive tribal rites and taboos were the origin of modesty; tribal custom said that parts of the body should be covered, and clothing was made with this custom in view. There are some peoples in the Orient today who feel disgraced if their faces are exposed in public, and some African tribes insist only that their chins be covered. Modesty is an outgrowth of old customs, but it is a powerful force in the choice and design of clothing.

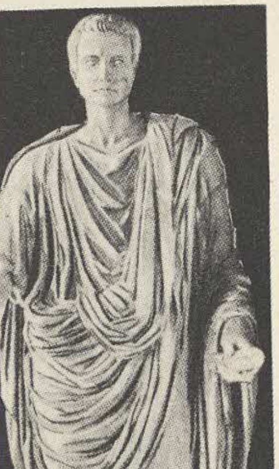
Such a necessity as clothing has brought about the growth of vast industries devoted to supplying clothing. Billions of dollars are invested in factories, machines, and stores where garments are made and sold, laundered and repaired. Millions of men and women till the soil to grow cotton, herd sheep and goats, and work in mills and behind counters to convert materials into clothing and to distribute it.

Cotton is made into dresses, coats, suits, shirts, undergarments, pajamas, socks, ties, and other articles that help to make up the costumes of men and women. Wool is sheared from sheep, and hair from camels. Men cultivate the silkworm to obtain threads from the cocoons to give the world soft, fine cloths. Trappers brave the frigid blasts of the northland to obtain rich furs. Wood and plant cellulose is converted into silklike threads called rayon, and dresses are even made of spun glass and metals. Hides of cattle, lizards, and alligators are made into shoes, belts, slippers, and boots. Sea shells, wood, rubber, silver, glass, chromium, and other metal and composition materials are manufactured into ornaments, buckles, hooks and eyes, braces, garters, clasps, zippers, pins, and decorations for men's and women's clothes.

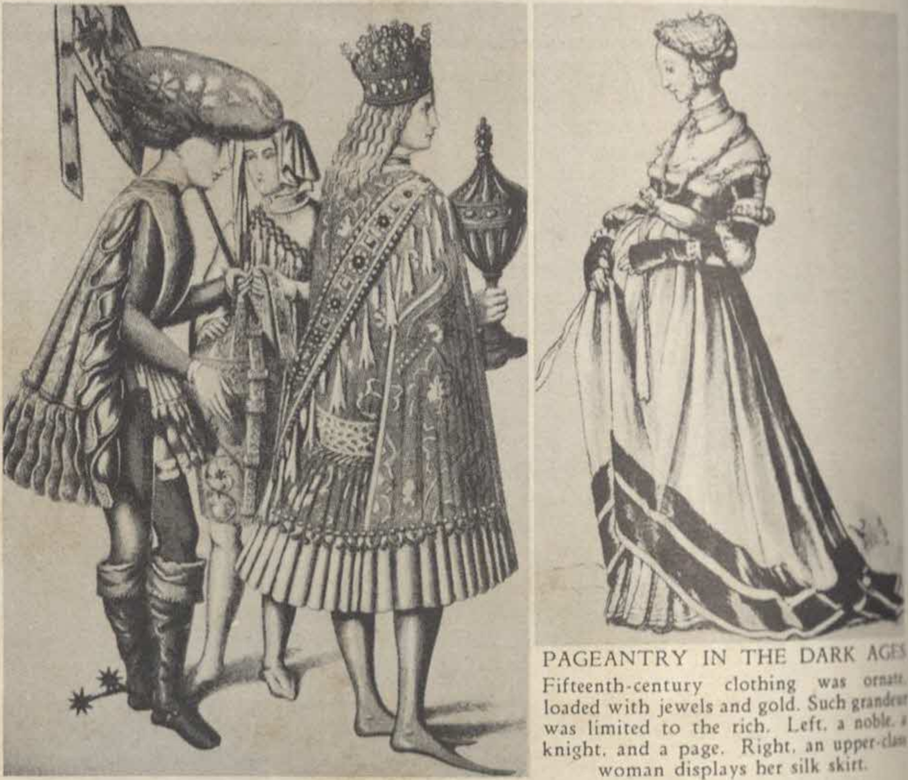
THE PARADE OF STYLE

Prehistoric and Primitive Dress. From relics found in caves, in the earth, and in mounds, we know that prehistoric man wore necklaces and bracelets of animals' bones and teeth and shells. Primitive people still wear such ornaments, and, of course, civilized persons adorn their necks and wrists with modern jewelry. The skins of animals were man's first real garments,





SIGNS OF ARISTOCRACY IN ANCIENT DAYS
What little the early Egyptians wore was elaborately decorated to denote rank (above). Right, a Roman Senator's regal toga.



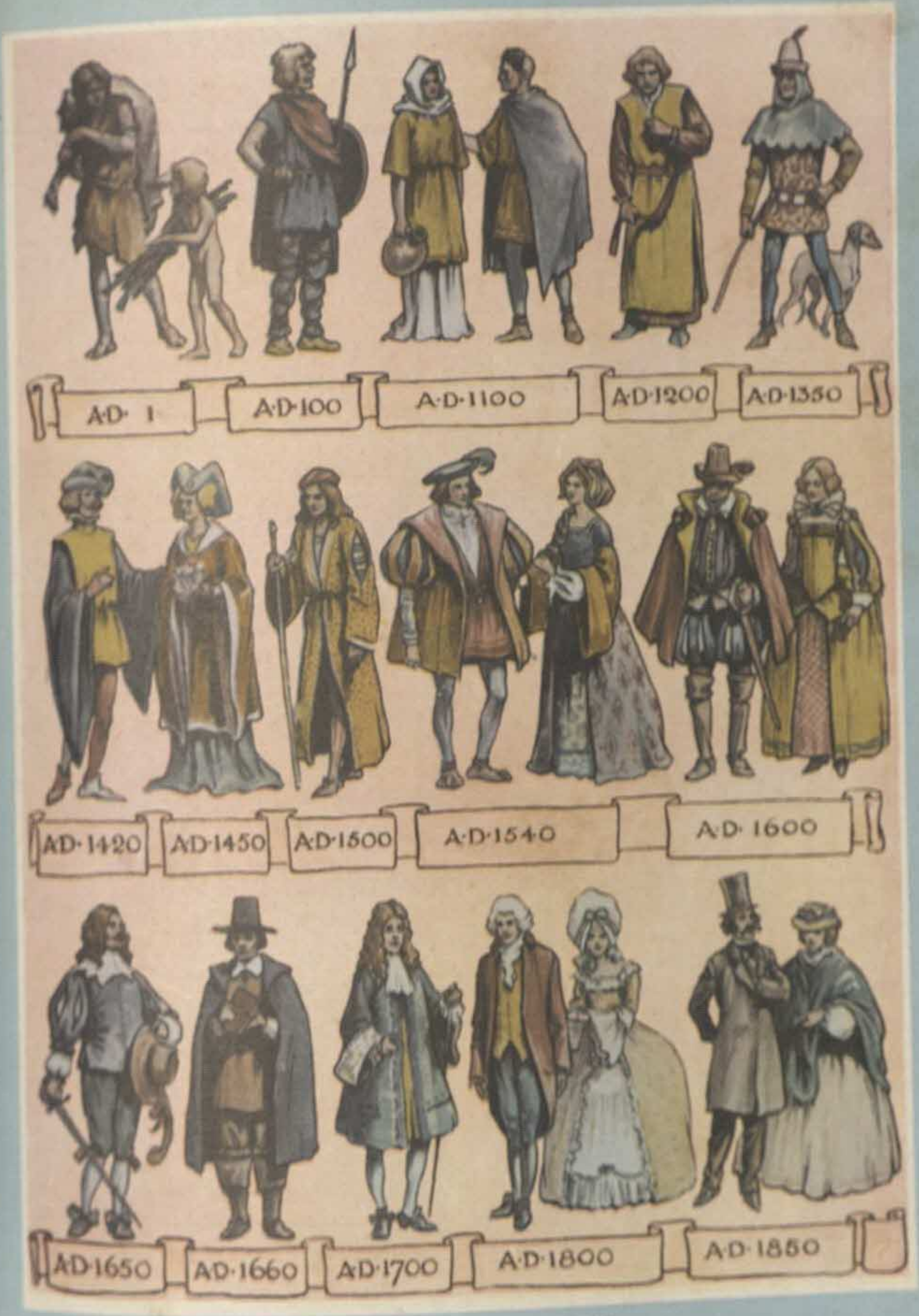
PAGEANTRY IN THE DARK AGES

Fifteenth-century clothing was ornate, loaded with jewels and gold. Such grandeur was limited to the rich. Left, a noble, a knight, and a page. Right, an upper-class woman displays her silk skirt.

and as he learned to weave, he made fabrics. Woven material was used for clothing straight from the loom. The ancient dress of woven goods was usually in the form of a square shawl or blanket, fringed around the edges and decorated with symbols and designs. The cloth was wrapped or folded about the body and head; and, since men had to use both hands, a belt was employed to keep the clothing in place.

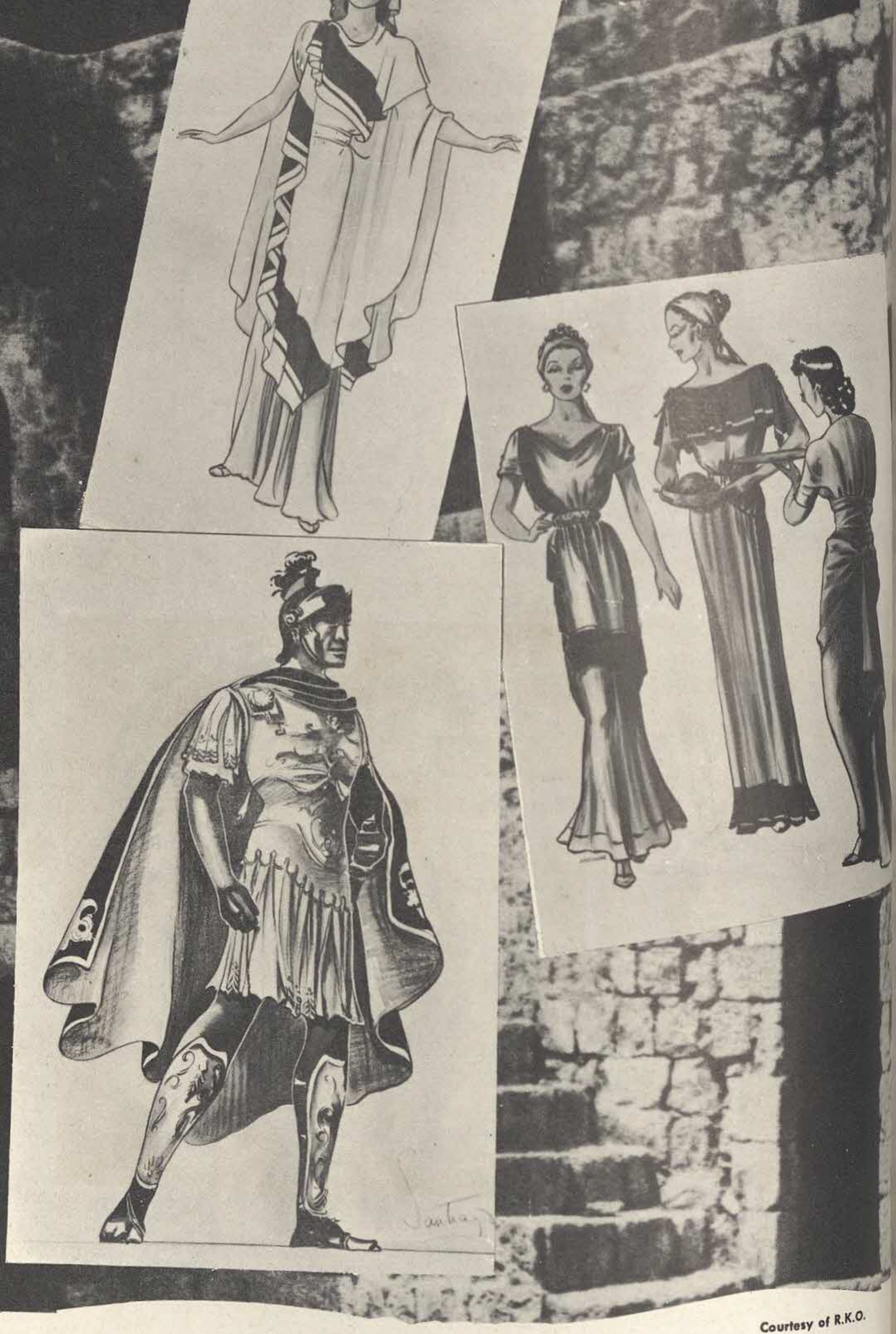
As time went on, one piece of cloth became two, although in some countries, such as India, one piece is still the principal garment. The upper part of the two-piece garments became the *tunic* in Egypt and Greece. South American Indians used one piece, cut a hole in the center, and made a *poncho*. The *toga* of the Romans was an extra shawl or robe originally worn for protection against the weather, but later worn for ceremonial dress. In Japan two pieces of cloth were fashioned into a *kimono*. The Indians of North America who needed more protection than a piece of cloth, made *leggings*, or *trousers*, to protect their legs. Furs have been used as clothing since very early times and have for centuries been cut into patterns by the Eskimos.

Egypt, Greece, and Rome. The first civilized people known to have worn any form of dress were the ancient Egyptians. From drawings on walls, mummy cases, and tombs, we have learned that they did not wear much; but what they did wear was artfully conceived and decorative. The lower classes wore little or no covering, but the upper-class women wore a tunic which reached from the bust to the ankle; the men wore skirts. Later, however, two skirts were made for men, the outer skirt becoming shorter and shorter, while the under skirt lengthened. The king wore the



A PAGEANT OF COSTUME

Men and women have changed the style of their dress throughout the ages. From animal skins to silks and satins, ruffles, and lace, the styles have changed in a continuous cycle. People of former years affected more elaborate clothes than they wear today, and fashionable men, as well as women, delighted in wearing brilliant costumes on everyday occasions. For many centuries men wore hosiery which displayed the leg. Dress is a reflection of the conditions of the age. The skirted dress of women has remained essentially the same for centuries, but with many modifications determined by changing styles and practical requirements. The voluminous, hooped skirt of an earlier period would be entirely unsuited to the needs of the modern business woman. The elaborate dress worn by men in past centuries is not suitable for this streamlined age.



Courtesy of R.K.O.

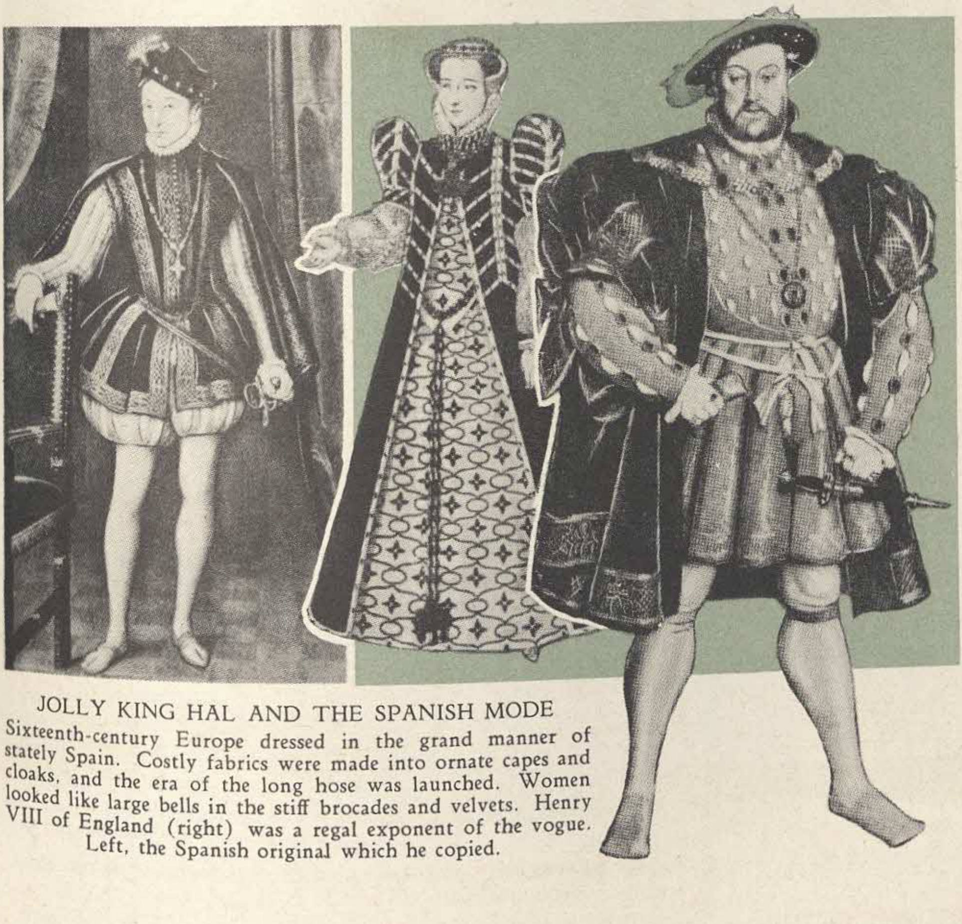
COSTUMES OF THE FIRST CENTURY A.D.

These Roman costumes, designed for the technicolor motion-picture production of Lloyd C. Douglas' novel *The Robe*, portray the dress of the people at the time of Christ. Shown here are a centurian, with his crested helmet, short tunic, and flowing mantle, and women in the long, draped *stola*, or gown of the period.

same costume, with the addition of an apron. Dyes were used to color the goods, and wigs and false beards were in general use.

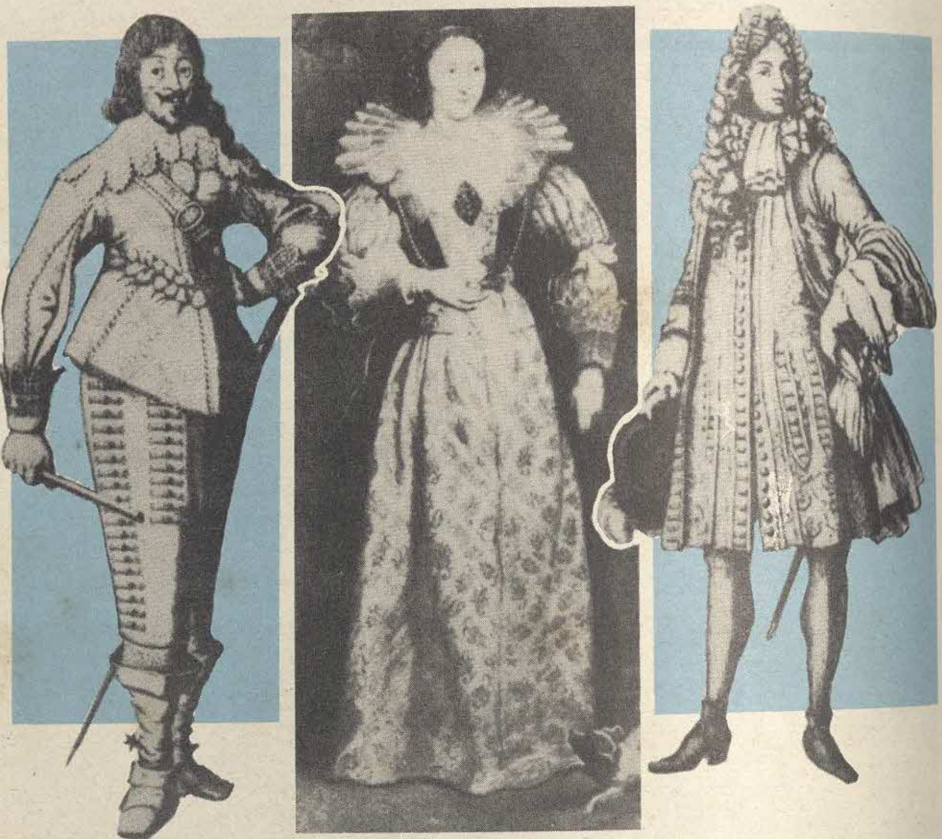
With Grecian men and women simplicity prevailed. The spirit of simplicity pervaded their architecture, their literature, and their general mode of living, and it also dominated their dress. Grecian garments consisted of two simple robes. Men wore the *chiton,* a garment folded about the body under the arms; the *himation,* an oblong piece of linen or wool, was draped over the chiton as an outer covering. The women wore a loose chiton with a girdle set high, creating a high-waisted effect which has often recurred in the fashions of the periods. The *peplos,* a woolen shawl, was sometimes draped over a woman's chiton. The Greeks wore broad-brimmed hats for traveling and also developed the use of shoes and sandals.

Rome, following in the footsteps of Greece, contributed the toga to the pageant of style. It resembled the Greek himation, except that it was cut in a semicircular pattern. It was sometimes as long as eighteen feet, and the colors were determined by custom. Upper-class and noble Romans wore purple and gold togas, but those in the lower classes had to don togas of a single, drab color. Boys of high rank wore white togas with purple borders, and, when they were older, plain white. The plain white toga was also reserved for ceremonials. Footwear consisted of sandals, slippers, and boots. One contribution of the Romans was the handkerchief, called a *sudarium.* It was carried in the *sinus,* or pocket formed by the folds of the toga.



JOLLY KING HAL AND THE SPANISH MODE

Sixteenth-century Europe dressed in the grand manner of stately Spain. Costly fabrics were made into ornate capes and cloaks, and the era of the long hose was launched. Women looked like large bells in the stiff brocades and velvets. Henry VIII of England (right) was a regal exponent of the vogue. Left, the Spanish original which he copied.



THE AGE OF "DELICACY" BEGINS WITH CURLS AND LACE

The days of *The Three Musketeers* saw a new refinement in dress. Clothing remained ornate, but lace replaced brocade and myriad buttons served instead of fur. Left, a courtly Englishman of the time. Center, an aristocratic woman. Right, a seventeenth-century Frenchman.

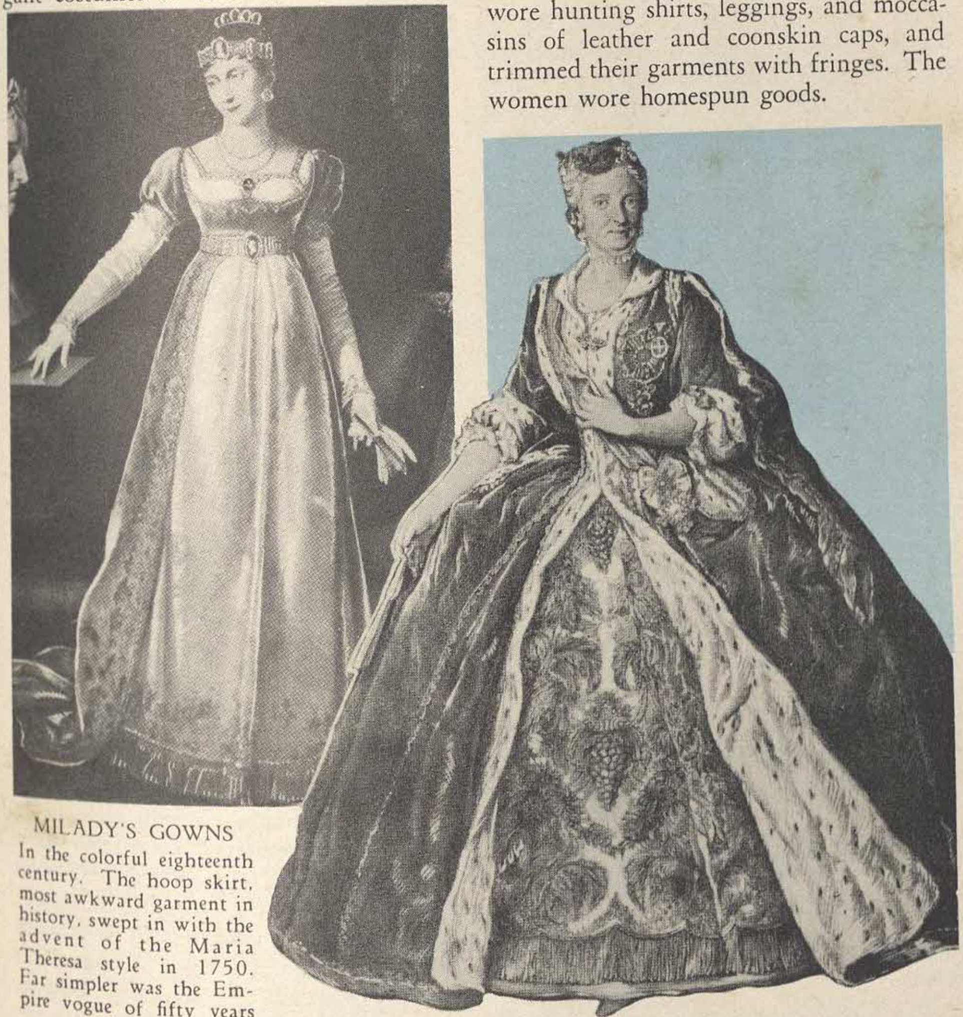
The Middle Ages and the Renaissance. Until the Middle Ages, fitted costumes were little known. They were worn principally by the barbarians in the cold northern countries of Europe. When the Romans expanded their empire northward, they found the barbarians wearing trousers and tunics; and a new type of dress developed. The costumes, of course, were varied; but when the Crusades took place, the costumes became very elaborate. Contrasting colors were used in stripes, spirals, and various designs. Shoes were long and pointed; headgear was grotesque. Men wore long hose and breeches. Their gorgeous shirts had puffed sleeves and elaborate decorations. The gowns of the women were long and small-waisted. Color decidedly ruled the fashions of the time.

The Renaissance brought the *farthingale*, which took the form of hoops, crinoline, pouf, and, later, the bustle. Skirts grew so extravagant in those days that some were many feet wide. In the sixteenth century, the era of Queen Elizabeth of England, ruffs about the neck appeared, said to have been originated by a Spanish princess who wished to hide a defect on her neck. Men adopted the same custom of wearing starched, ruffled collars. Later the high-backed collar became fashionable. During the Reformation the *falling band*, or low collar, came into use. At that time hair was worn long and hid the neck, doing away with the need for a collar. Hoops in skirts, which had disappeared for awhile, returned. The women sought to make their waists as small as possible.

The seventeenth century saw high boots and the doublet come into vogue with men. From this fashion evolved the knee breeches, replacing the long hose; and then came the coat. Women discarded the corset shape and shortened the waist line and the skirt.

Colonial America. Fashions in America in colonial days ranged from the extravagant costumes of the South and Middle Atlantic colonies to the somber, simple dress of the New England Puritans. As the colonies prospered, rich goods were brought from Europe; and finer and costlier garments appeared. Hoops returned for women's dresses. Powdered wigs were worn; fans and jewelry were customary. The men wore knee breeches, hose, a waistcoat, three-cornered hats, powdered wigs, and lace. Both men and women carried muffs.

At the same time, the people on the frontier were wearing costumes more suited to their surroundings. The men wore hunting shirts, leggings, and moccasins of leather and coonskin caps, and trimmed their garments with fringes. The women wore homespun goods.



MILADY'S GOWNS

In the colorful eighteenth century. The hoop skirt, most awkward garment in history, swept in with the advent of the Maria Theresa style in 1750. Far simpler was the Empire vogue of fifty years later.

The Nineteenth Century. Styles in the United States changed materially after the Revolution. The influence of France was felt, and Paris still sets many of the fashions for American women. The dress became more sober since there was little material imported during the Revolution. The long, clinging empire dress of the Napoleonic period took the place of wide skirts and hoops. Women wore low-heeled shoes. *Pantaloons* replaced knee breeches for men about 1800, and laid the foundation for long trousers. Men also wore long capes and beaver hats.

The romantic period in dress began about 1830 when medieval styles returned for women. The fashion then was to acquire an "hourglass" silhouette. The skirts became very full about 1840; and a decade later the crinoline became fashionable. The crinoline consisted of a series of wire hoops over which several petticoats were placed. Women glided into a room rather than walked. Men's fashions became standard about this time, with the long trousers, waistcoat, suit coat, and overcoat. In 1870 and later, the full skirt was gathered up in back in a *tie-back*. This fashion paved the way for the bustle which characterized the later years of the century.

The Twentieth Century. Skirts became narrower in the last years of the nineteenth century, and by 1911 women hobbled rather than walked because their skirts were so tight. With the First World War came more freedom in women's clothing: shorter skirts, straight lines, and general simplicity. By 1926 the skirts had become knee-length. The trend to longer skirts began in 1929, and variations have been made ever since.

The quickening pace and changing ideas of the twentieth century have had a profound influence on fashions in clothes. Swift, easy communication has brought an interchange of ideas, creating a greater demand for more and ever-new styles for women. Since they began participating more actively in business, public life, and sports, fashions for them have been greatly simplified and much more varied.

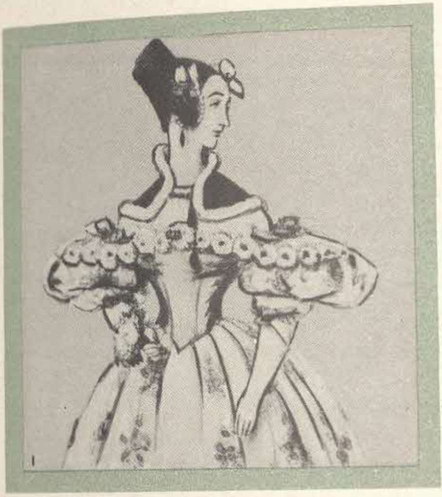
The growth of the ready-to-wear clothing business, which originated in Germany in the 1800's and has since reached its greatest development in the United States, has made fashionable dress available to practically everyone at a reasonable cost. To increase their profits, most manufacturers of such clothing, especially of women's and children's garments, introduce new styles every season or even oftener, as do the makers of patterns for home sewing.

Parisian designers still create many of the expensive, ultra-fashionable garments worn by the wealthy women of Europe and America. Many of their styles are also still copied or adapted by foreign manufacturers of popularly priced women's clothing. Since the start of World War II, however, the demand for American-created fashions has rapidly increased in the United States. After the war, styles brought from Rome also became a real challenge to those originating in Paris.

Spreading Fashions. Many of the fashions that have become popular, especially in America, have been introduced by stage, movie, or television stars, or by wealthy social leaders. Magazines, newspapers, fashion shows, and countless advertisements also help to popularize current styles in garments, hats, and shoes and to create a demand for new clothes.

A Never-Ending Cycle. Although changing often, most fashions are only revivals of older styles. For example, the simple lines of women's dresses in the 1920's existed among primitive peoples, and many other "modern" styles have been popular at numerous earlier times.

Despite the changes, certain peculiarities in dress have remained for many years. For instance, the buttons on the sleeves of men's coats have no purpose today, but once buttons were used to hold up the lace cuffs on gentlemen's coats. Tailors have merely carried on the tradition. Buttons on the back of cutaway coats formerly were used to hold up coattails when men went



THE ERA OF REVIVALS

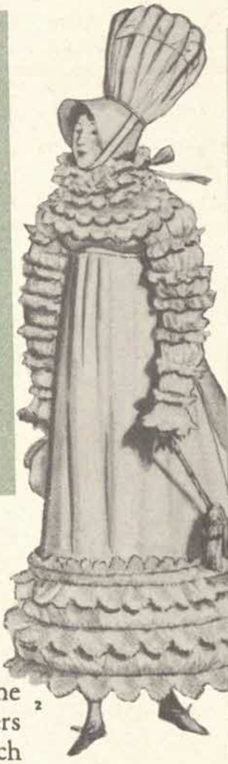
Many older styles revived in the nineteenth century. (1) "Crinoline days," with frills. (2) "Neo-Empire" tube gown. (3) Gentleman. 1820. (4) 1877, with brocade again. (5) Ultra-smart in 1850.

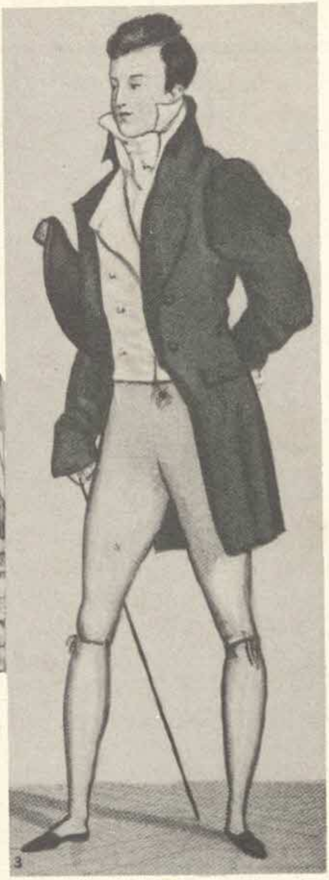
horseback riding. The stripes along the sides of dress-suit and military trousers have simply replaced rows of buttons which existed when trousers were narrow. The notch in the lapel of the coat once had the purpose of allowing men to turn up their collars without affecting the front.

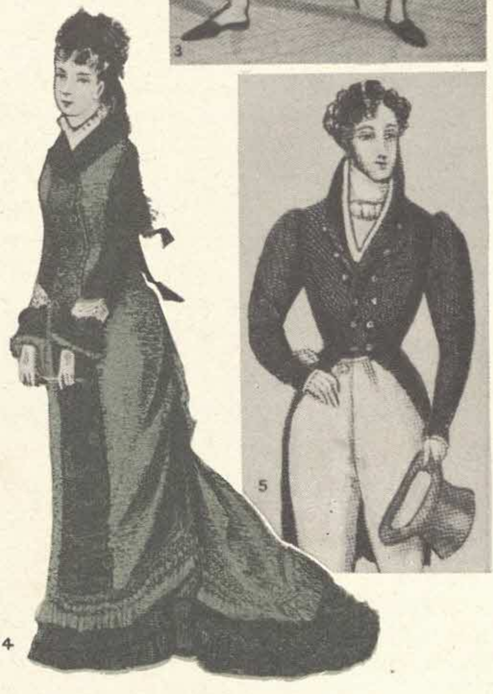
One other peculiarity has existed since ancient days: men's coats button on the right side; in times past, a man needed his right hand to wield a gun or sword, necessitating the use of the left hand for handling the buttons. Women's coats button on the left side because it was the custom for women to carry their infants on the left arm, leaving the right arm free to adjust their clothing.

For additional information, consult the following articles:

Boots and Shoes
Buttons
Calico and Calico Printing
Cloth
Cotton
Dyeing
Felt
Flax
Fur and Fur Trade
Glove
Hat
Hemp
Lace
Leather
Linen
Mohair
Tunic
Turban
Wool
Textiles







DREYFUS, *dra'fus,* ALFRED (1859-1935). The central figure of one of the greatest plots that ever shook a nation, Alfred Dreyfus, a Jewish officer in the French army, will always be remembered as a victim of injustice and bigotry.

Born of a wealthy family, Dreyfus entered the army and rose to a minor rank in the French war department. In 1894 he was accused of selling military secrets to the German government, and, in a private trial, and upon flimsy evidence, was convicted and exiled to the notorious Devil's Island, in French Guiana.

Because of the secrecy of the trial and the weakness of the evidence, many liberals in the nation believed that Dreyfus was innocent. Led by his brother, Matthieu, and Emile Zola, the noted French writer, the liberals demanded his release. In 1896 Colonel Picquart of the intelligence department discovered evidence indicating that Dreyfus was innocent, and that a certain Major Esterhazy was the real culprit. Esterhazy immediately was demoted and sent to an outpost in Tunisia.

France then split into opposing camps. Many royalists and prejudiced persons reviled Dreyfus because of his Jewish faith. The highest men in the nation were involved, and the scandal precipitated a serious crisis in the French government. Zola published his famous attack on the government, "J'accuse" (I accuse), for which he was sued and found guilty. But he and other leaders, among them Georges Clemenceau, later to be World War I Premier, continued to fight.

At last, in 1899, Dreyfus was tried a second time, and again was found guilty. He was pardoned, however. Seven years later he succeeded in winning complete vindication from the French Court of Appeal. He was appointed major in the army and, during World War I, proved himself an officer of extraordinary ability.

Since that time, German papers have completely vindicated Dreyfus, but the scandal left scars in France for many years. It resulted in the confessions and suicides of several men who manufactured the evidence against Dreyfus, and it discredited those responsible for kindling the flames of racial prejudice.

DROWN'ING. Suffocation, or *asphyxia,* caused by liquid filling the air passages and preventing air from reaching the lungs and carbon dioxide from discharging, is drowning. No great amount of water or other liquid is required to bring about death in this manner, since only the mouth and nose need be stopped to cause suffocation. Drowning persons, if quickly treated, have a chance to recover, although they may be unconscious when rescued.

First Aid in Drowning. The objects of treatment are to permit access of air to the lungs by removing the water; to supply the lungs with air by artificial aid to respiration, if the patient is not already breathing; to sustain the heart's action, and, finally, to overcome shock. To render efficient aid, a fair knowledge of the application of artificial respiration is necessary, and the time element is important, because every second counts.

The Schaefer method of resuscitating the drowning is universally indorsed by all who are experienced in this matter, and is taught to all pupils in the classes of the American Red Cross. It is employed most successfully only when one is thoroughly familiar with its practice and understands just what results he is attempting to secure in its use. It is recommended that everybody should practice the method at home, and thus be prepared for the real emergency when it comes. Remember that pulmotors usually are not at hand and are not always safe to use; that rolling the patient on a barrel possesses no peculiar advantage, requires much assistance, and involves too much delay.

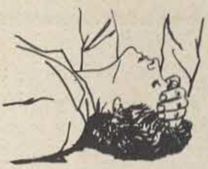
When the patient has been taken from the water, turn him face down on the ground, but with his face elevated by having his forearm placed under his forehead. (If he is lying on his back, do not wait for assistance, but turn by seizing his wrist and drawing him quickly into place.) If his head lies lower than his body, as on a shelving beach, so much the better. If his nostrils or mouth are obstructed with mud, this must quickly be removed. In the position above described, water tends to run from the mouth and nostrils; the tongue also drops forward in such manner as not to interfere with respiration.

It is well to lift the patient, for a few moments, to permit the water to flow out freely; this is done by standing over him, grasping his body around the abdomen, and lifting him high

BREATH OF LIFE

Drowning victims or persons with foreign objects in their breathing passages may be started breathing by the oral method of resuscitation, also called the mouth-to-mouth method. All visible foreign matter is removed from the victim's mouth, using the fingers or a cloth wrapped around the fingers. Then, Figure 1, tilt the victim's head back and, Fig. 2, push or pull the jaw into a jutting position. If the victim is a small child, place your mouth tightly over its mouth and nose, and blow gently into its lungs about 20 times a minute. If an adult, Fig. 3, pinch the nostrils shut and cover the mouth with your mouth, blowing vigorously about 12 times a minute. If air will not enter the lungs, and the head and jaw positions are correct, suspect foreign matter in the throat. If the victim is an adult, place in the position of Fig. 4 and slap sharply between the shoulder blades. If a child, follow Fig. 5 and use the same procedure.

The American National Red Cross



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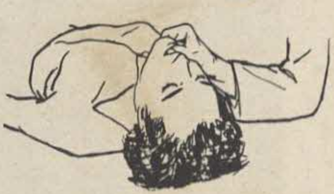

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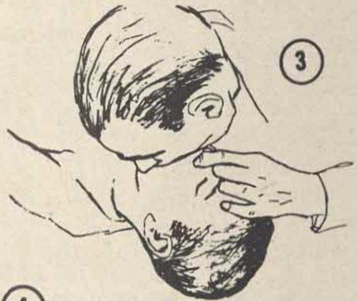

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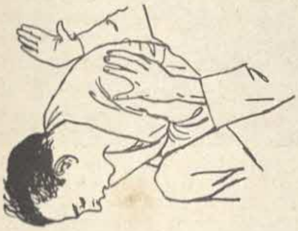

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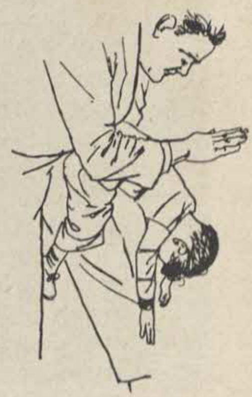

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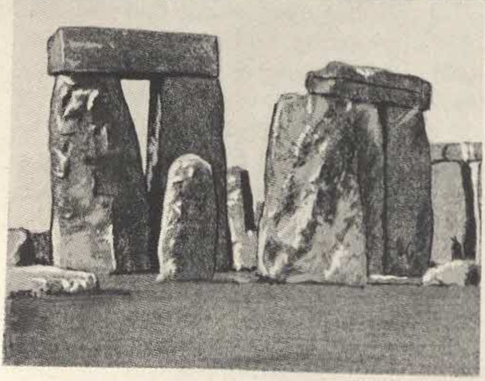
enough to allow the face to clear the ground. (This is the only maneuver requiring strength. It usually can safely be omitted, or the body may be raised by placing some folded garments under it.) Quickly replace patient in former posture. Kneel astride his body. Place the open hands over the back and sides of chest, a little above level of last ribs. Lean forward and exert enough pressure to flatten patient's chest somewhat, thus expelling water and air. Quickly release pressure and thus permit the ribs to spring back in place; this movement allows the lungs to expand with the ribs, whereby air is drawn in. Keep up the movements at the rate of sixteen or eighteen to the minute. When the patient begins to breathe, stop the exercise, but renew it if the respirations die out.

Meanwhile, shock has to be combated. The treatment is heat and stimulation. As soon as possible, warm the patient by removing wet clothes and wrapping him in blankets. When he can swallow without vomiting, give him hot coffee or tea, or stimulate him with aromatic spirits of ammonia, one teaspoonful diluted with hot water, to be repeated once or twice.

It is possible for one to remain long under water without getting much of it in the lungs. Do not waste time in inquiries, but go to work over the patient and keep up the efforts until sure of the final outcome.

Methods of Rescue. To rescue a drowning person by swimming requires much skill, as well as practical instruction. One important rule for the rescuer is to seize the drowning one from behind and then swim on the back, holding the individual by the hair of the head, or by grasping him under the arms or around the lower jaw. If the rescuer is endangered by the struggles of the other, he must try to render him unconscious by a blow on the point of the chin, or by immersing his head.

Better still, when possible, is to throw a line to a drowning person, to make a line by holding hands, or for the rescuer to swim out with a line, whereby both he and the one to be rescued will be certain of being drawn back to safety.



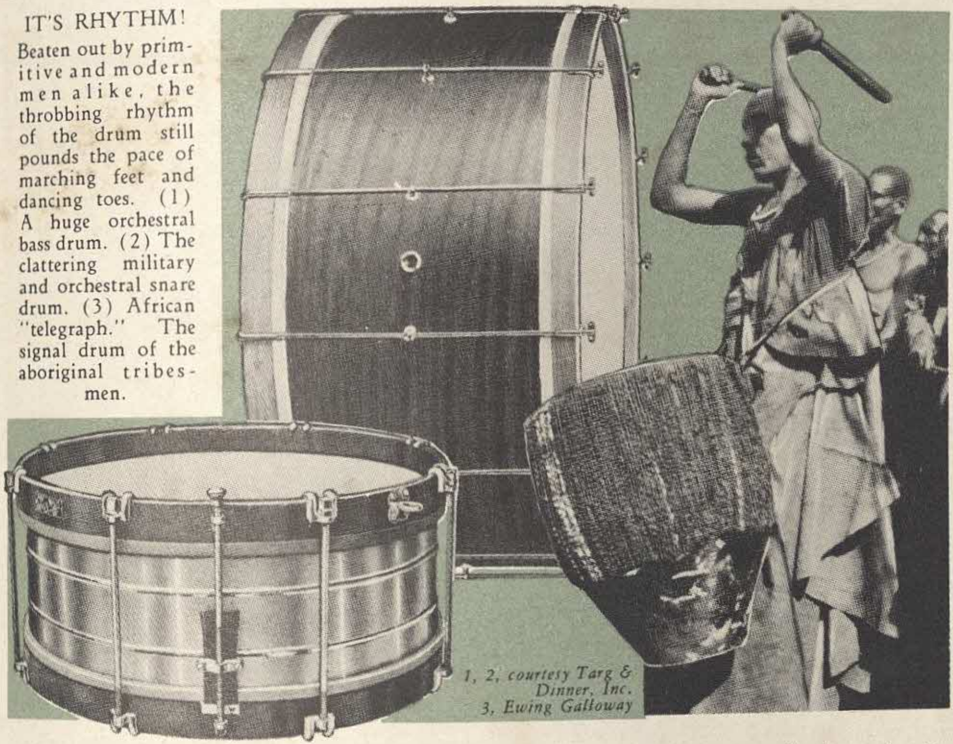
PRIMITIVE ENGLAND'S MYSTIC FAITH

Druidism was the ancient sacrificial religion of the early Celts (above). Left, Stonehenge, supposedly the Druids' greatest temple.

DRU'IDS. Weird and mystic ceremony surrounded the activities of the Druids, the priests of pre-Roman England. Their worship was steeped in gloomy superstition, but at their height they were the controlling influence over the people and the best-educated men of their time. As among most primitive societies, the Druid priests were dominant in the government of the people and the administration of justice.

Remains of the altars and primitive temples of the Druids still stand in England. At Stonehenge, for instance, there are huge circles formed of great, rough-hewn stones surrounding a crude altar (see illustration under ARCHAEOLOGY). But little is known of the proceedings which took place there. Julius Caesar, who invaded England in 55 B. C., told of their existence, but little else.

Druidism does not appear to have been based upon any great philosophy, but upon beliefs in ancient Celtic gods. To these were offered burnt sacrifices and complicated rites of supplication. The priests selected a superior priest to rule them for life.



IT'S RHYTHM! Beaten out by primitive and modern men alike, the throbbing rhythm of the drum still pounds the pace of marching feet and dancing toes. (1) A huge orchestral bass drum. (2) The clattering military and orchestral snare drum. (3) African "telegraph." The signal drum of the aboriginal tribesmen.

1, 2, courtesy Targ & Dinner, Inc. 3, Ewing Galloway

DRUM. A natural sense of rhythm is essential to players of the drum, said to be the first instrument known to man.

The drum is an instrument of *percussion:* that is, sound is produced by beating upon it. Three types are in general use—the *bass* drum; the *snare,* or *side,* drum; and the *kettledrum,* commonly used in pairs technically known as *tympani.* The bass drum and the snare drum are cylindrical and have two parchment-covered *heads,* or disks.

The bass drum is the larger and more sonorous of the two. It is played with a rather flexible stick having a padded head about the size of a tennis ball. It is used in marching and in dance music to emphasize the rhythm; it frequently imitates the roll of cannon or of thunder.

The snare drum is smaller than the bass drum and takes its name from gut *snares,* or strings, stretched across its lower disk. It is called the *side* drum, too, from the position in which it is carried. Two sticks are used in a great variety of strokes, known by such names as *single* or *double* strokes, *flams* and *rolls.* The snare drum belongs to the military band and the drum corps, and is most effective in them.

Kettledrums are great hemispheric bowls or copper kettles, as their name implies. Their tops are covered with calfskin, the tension of which is regulated by screws set around the circumference. Kettledrums are the only drums having definite pitch. At least two kettledrums, or tympani, are employed in the orchestra. The tympani reinforce not only the rhythm but the bass as well, and add to the harmony. They are used in orchestras and in cavalry bands.

DRY'ADS. It was the belief of the early Greeks that every living tree was the home of a wood nymph or dryad. When the tree died, the dryad also perished. Consequently, the gods punished anyone severely who dared to destroy a tree.

Dryads were imagined to take many forms, such as shepherdesses, peasants, and maidens of the hunt. One of the most important of these mythical beings was Pomona, who presided over fruits. See Nymphs; Mythology.

DRY BATTERY. See Electric Battery.

DRY'DEN, John (1631-1700). Known for his drama and poetry, John Dryden, once poet laureate of England, is credited with setting the style for modern English prose. Dryden was the leading English writer in the Restoration Period, and although he had great influence on the poetry of his day, he is best remembered for his work as a critic and political satirist.

He was born near the little town of Aldwinkle, Northamptonshire, the son of a family of considerable means. He was educated at Cambridge, and went to London shortly before the death of Cromwell in the hope of obtaining a government position through an influential relative. When Cromwell died, Dryden wrote an elegy in his memory, but after the Restoration of Charles II, Dryden welcomed the new king in a long poem called *Heroic Stanzas.*

From the first, Dryden depended upon his writings for income, and soon after the Restoration he began writing plays. He wrote nearly thirty comedies, tragedies, and heroic dramas and all were successful with the exception of the first, *The Wild Gallant,* produced in 1663. Although none of his plays had great merit, they were so popular with Restoration audiences that Dryden became the leading dramatist of his time.

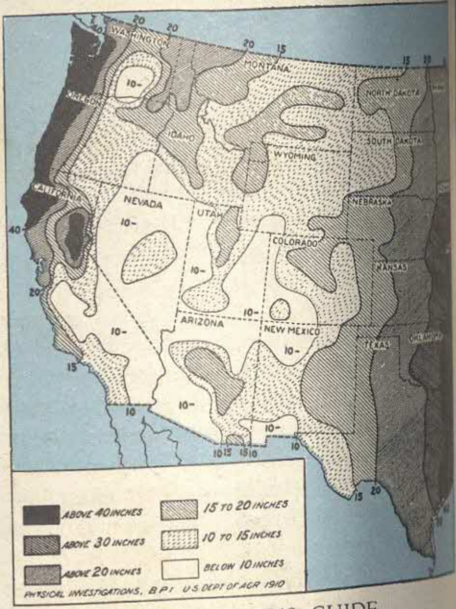
In 1670 Dryden was made poet laureate. He wrote a few odes and lyrics, but his principal poems were satires. Among them, *Absalom and Achitophel* and *The Medall* dealt with political matters; *MacFlecknoe* attacked Thomas Shadwell, who had offended Dryden. *Absalom* and *Achitophel,* an allegory of contemporary politics, attacked the Earl of Shaftesbury for plotting to make the Duke of Monmouth king.

Some of Dryden's best writings were in defense of the Church of England and the king. He honored his Church in his poem *Religio Laici,* but when James II took the crown in 1685, Dryden became a Roman Catholic. His change of faith was celebrated by the poem *The Hind and the Panther.* Three years later, the Revolution of 1688 drove James II from the throne, and his successors, William and Mary, were Protestant. Dryden therefore lost his laureateship.

In the last years of his life, he turned his attention to translations of the classics, and also produced, among other fine odes, the beautiful *Alexander's Feast,* in honor of Saint Cecilia's Day.

DRY DOCK. See Docks.

DRY FARMING. Millions of acres of land in the United States and Canada have neither irrigation nor sufficient rainfall to carry on ordinary farming. In such cases, the farmers must resort to dry farming.



DRY-FARMER'S GUIDE

Soil moisture in dry-farming regions must be conserved to the utmost. What a farmer can grow depends upon his skill.

Regions having less than ten inches of rainfall yearly are valueless for farms unless irrigated; but in areas where rainfall varies between ten and twenty inches, skillful dry farming so conserves and stores the moisture that good crops can be raised.

Under this system, the land is plowed deeply in the fall. The winter rains and

Irish Tourist Association

UPI

DUBLINERS LIKE DRAMA AND PAGEANTRY

The modest building, above left, houses the Abbey Players, a famous repertory group whose plays and playrights are known all over the world. One of Dublin's many parades, festivals, and religious ceremonies, above right, passes before the reviewing stand at the General Post Office.

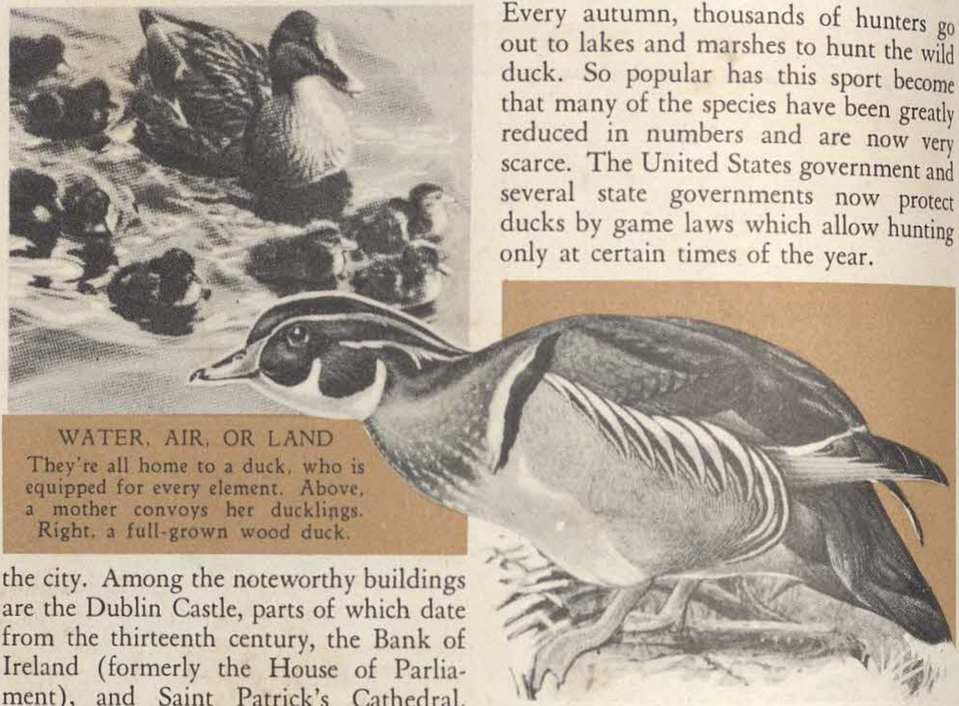
snows are thus allowed to soak into the ground. In the spring the ground is harrowed before sowing and cultivated as long as the growing crops will permit. This fine soil is then packed or rolled, changing the surface almost to a dust and keeping the moisture locked in the ground. This dusty topsoil will often be fully three inches in depth. Over fifty per cent of the year's rainfall may thus be conserved.

Wheat and kaffir corn are the leading crops raised by this method of farming, though corn, potatoes, alfalfa, sugar beets, and even fruit orchards are cultivated.

There are in the United States about 800,000 acres which can be cultivated by the dry-farming method. Most of this area is in the Western states, and includes much of Texas, Kansas, Nebraska, the Dakotas, Montana, Wyoming, Colorado, and New Mexico. In Canada, too, dry farming is carried on over large parts of Saskatchewan and Alberta.

DUB'LIN, EIRE. Situated upon the east coast of Ireland at the mouth of the river Liffey is Dublin, the beautiful capital of the former Irish Free State. One of the country's leading ports, Dublin is separated from Liverpool, the greatest port in England, by 135 miles of the Irish Sea. The banks of the Liffey are lined with docks for more than two miles from the sea. Two canals connect Dublin with North and West and South Ireland, and railroads reach out to all parts of the island.

Running through the heart of the city is Sackville Street, a beautiful avenue 120 feet wide, which crosses the river by way of O'Connell Bridge. Beautiful buildings, well-kept squares, and many statues mark



WATER, AIR, OR LAND
They're all home to a duck, who is equipped for every element. Above, a mother convoys her ducklings. Right, a full-grown wood duck.

the city. Among the noteworthy buildings are the Dublin Castle, parts of which date from the thirteenth century, the Bank of Ireland (formerly the House of Parliament), and Saint Patrick's Cathedral. Northwest of the city is Phoenix Park, embracing about 1,760 acres and noted for its race track, zoo, and gardens. The University of Dublin (Trinity College), National University, and Leinster House, where the national Parliament meets, also are in the capital.

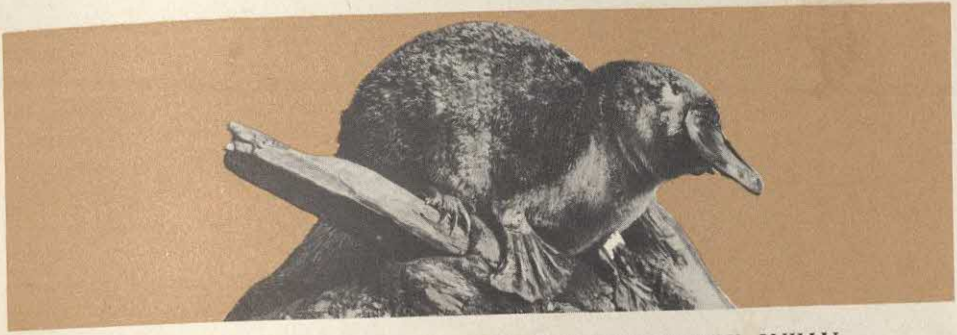
Captured by the invading Danes in the ninth century, Dublin remained mostly in their hands until wrested from them by the English conquest in 1171. Numerous rebellions have centered about Dublin, the most serious being the Easter Rebellion in 1916. After the destruction of much government property and the loss of many lives, the rebellion was finally put down, and the leaders were executed or imprisoned. The population of the city is about 506,000, mostly Roman Catholics.

DUCK. The quacking, waddling duck is one of the most beautiful members of a large family of water birds, when seen flying in the air or swimming on rivers and lakes. Ducks are found both wild and domesticated in all parts of the world, and both kinds are considered excellent food. Every autumn, thousands of hunters go out to lakes and marshes to hunt the wild duck. So popular has this sport become that many of the species have been greatly reduced in numbers and are now very scarce. The United States government and several state governments now protect ducks by game laws which allow hunting only at certain times of the year.

Ducks are closely related to the mergansers, the geese, and the swans. The term *duck* is applied specifically to the female, and the male is known as a *drake*. Ducks vary in size from one to six or possibly eight pounds. The plumage of some is a quiet mottled gray or brown or black; in others there are brilliantly colored markings. The males are usually more brightly colored than the females during most of the year.

All ducks molt after the breeding season, and the males of most species are then dull-colored for a few months. Later they molt again and regain their bright plumage. The feathers are very close and smooth, are underlaid with down next to the skin, and are kept well oiled from a gland above the tail. They are practically waterproof.

Wild Ducks. *River* and *sea* ducks are the two groups of wild ducks found in North America. River ducks feed in shallow water; their bills are so adapted that they can strain out the mud and water and retain the food they find. The most important member of the river-duck group is



NATURE'S QUEEREST CREATURE—THE PATCHWORK ANIMAL
The peculiar duck-billed platypus seems to be a combination of beaver, duck, and 'possum.

the *mallard,* from which many of the domestic ducks have come. It is a grayish-brown bird with a green head, white neck ring, and brown breast. Other members of the river-duck group are the *gadwall, widgeon, teal,* and *pintail.*

The chief difference between the river duck and the sea duck is that the latter has a webbed hind toe. Sea ducks live on the shores of large bodies of water and often gather into huge flocks. Except in the breeding season, they feed by day and spend their nights away from the shore. They obtain their food by diving, and some species have been known to go down nearly 200 feet. The *canvasback* is the best known of the sea ducks; particularly after it has been feeding on wild celery, it is highly prized as a game food. Other well-known sea ducks are the *Labrador,* the *ring-necked,* the *harlequin,* and the *bluebill.*

Domestic Ducks. The domestic duck ranks with turkey and chicken as a table delicacy. The raising of domestic ducks for commercial purposes is widespread and is an important source of farm income. The *Pekin,* a large white bird, is the most popular domesticated duck. The *Aylesbury* is also commonly bred, as are the *Cayuga* and the *Rouen* ducks.

DUCK-BILLED PLAT'YPUS, or DUCK'BILL. A strange creature, the duck-billed platypus belongs to the lowest order of mammals. It is a native of Australia and near-by islands, where it lives harmlessly in rivers and streams. It resembles a beaver but has a duck's bill and peculiar, webbed feet. It is usually a little less than two feet long and has a coat of brown hair.

The webbed feet are extremely awkward on land, but the animal is an excellent swimmer and spends most of its time in the water. Nostrils at the end of the bill permit breathing with just the tip of the bill above the surface. The duckbill lives on small insects and worms, which it hunts at night. Large colonies of the animals live together, each pair occupying a separate burrow in the bank of the stream.

DUCTIL'ITY. The property of a substance which permits it to be drawn into wires is called ductility. Most metals are ductile at ordinary temperature. Glass, glue, resin, and even quartz are ductile when heated. Platinum is more ductile than any other metal. It has been drawn into wires so fine that it would take thousands of miles of this wire to weigh a pound. This kind of platinum wire is now used instead of spider's thread for cross hairs in telescopes and microscopes.

Next in order of ductility among the metals come gold, silver, iron, copper, and aluminum. Glass and quartz, when white-hot, may be drawn into exceedingly fine threads. (Quartz threads a hundred-thousandth of an inch thick have been made which were nearly as strong as steel.) Very thin glass threads may be spun and knotted without breaking.

WHEN BRIGHT BLADES DEFENDED HONOR

Not the slightest insult went unavenged in the dramatic days of dueling. The offended party challenged his enemy and, according to a formal code, they fought to death or surrender.

DUEL. In only a few civilized countries, such as Germany, France, and some Balkan states, does the ancient custom of dueling still exist. Once a method of settling a quarrel between individuals, it is outlawed today in most parts of the world.

Duels are held usually at an isolated place early in the morning. The contestants, one of whom has challenged the other, fight usually with swords or foils, or revolvers. If revolvers are the weapons, the duelists stand an agreed number of paces apart and fire when a signal is given. A referee determines the rules, and each contestant has a *second,* or witness. Sometimes a surgeon is on hand to dress the wounds.

In Germany, before the World War, university students who belonged to exclusive orders considered it a badge of courage to show on their faces the scars of duels. In order to receive a scar, the contestant covered himself with protective clothing, leaving a small part of the face exposed. When the flesh had been cut, the duel ended. A surgeon disinfected the wound and dressed it, and the contestants parted friends. This custom has never wholly ceased.

Probably the custom of fighting duels arose from the medieval practice of sending two champions to fight each other to settle a personal dispute, or even to settle a war between the armies they represented. This practice, like the ordeal, was based on the belief that God would certainly grant the victory to the deserving contestant.

A number of notable persons in history have been killed in duels. One of the most tragic deaths from a duel was that of Alexander Hamilton, who was fatally wounded in a duel with Aaron Burr.

DUKE, DUCHESS, *dutch'es,* **AND DUCHY,** *dutch'e.* Next to a king or a prince, a duke ranks highest in European nobility. The title goes from father to eldest son; but during the lifetime of the father, this son holds the rank of marquis. The wife of a duke is called duchess.

In England and most European countries, a duke is simply a member of the highest nobility. But in some small nations, called duchies, the duke (or duchess, if there is no duke) is the sovereign ruler. The Grand Duchy of Luxemburg, a little country on the southern edge of Belgium, is ruled by the Grand Duchess Charlotte.

In England the title Duke of Cornwall was conferred by King Edward III upon his son, the Black Prince, in 1337. This was the first use of the title. Since then many of England's dukes have also been princes, sons of the king. Of course, the king may confer the title at pleasure; such was the case when George VI of England conferred it on his brother, the Duke of Windsor, who had been King Edward VIII before his abdication.

DUMAS, *du mah',* **ALEXANDER** (1802-1870). From the pen of Alexander Dumas, French novelist, flowed the fascinating and stirring historical novels, *The Three Musketeers* and *Twenty Years After.* Porthos, Athos, and Aramis—those dashing soldiers of fortune whose lives stand as literary pictures of France under Cardinal Richelieu—were the original *Three Musketeers.* D'Artagnan, who, by matching swords, won his way into the hearts of the three, became the fourth musketeer and hero of the tale. These novels form only a part of the series of novels which Dumas planned, to deal with the whole course of French history, and he took great pride in the fact that his stories were historically accurate.

Dumas was the son of a French general under Napoleon, and the grandson of a Haitian negress and the Marquis de la Pailleterie, a colonist in Haiti. From this grandmother he took the name Dumas. In 1823 he went to Paris, where he obtained a minor court position. After a period of writing light melodramas and sketches, he turned to more serious drama. *Henry III,* which delighted the Romantic school, attracted the attention of another French historical novelist, Victor Hugo. Other dramas, among them *Christine,* were rapidly produced. His fame, however, rests on his works of fiction. Among favorite historical romances which have been translated into English are *The Count of Monte Cristo,* the *Viscount Bragelonne,* and *The Black Tulip.*

Writing brought fortune to Dumas, and he turned out quantities of material. In some cases he simply sketched plots or revised the books before they were printed, leaving the detailed work to others. As a result, nearly 300 books are credited to Dumas' authorship. His wealth, however, could not withstand extravagance and dissolute living. He died at the home of the son whom he had neglected.

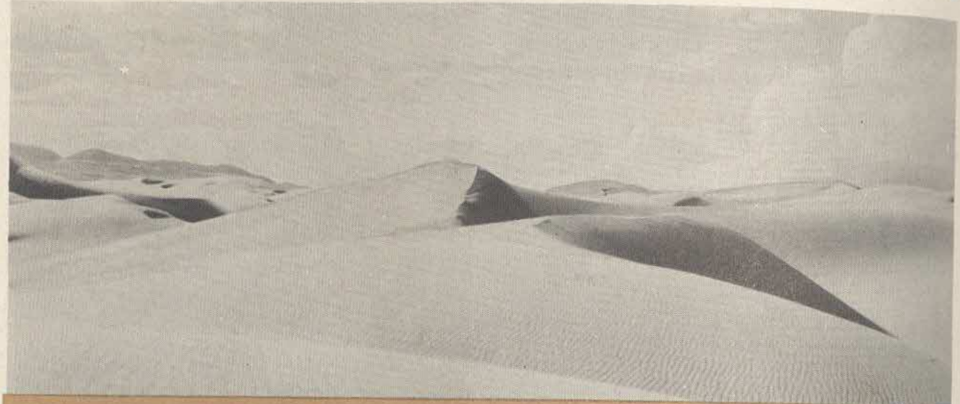
WEAVER OF STORIES
Alexander Dumas (the Elder), master of historical romance: author of *The Three Musketeers.*

DUMAS, ALEXANDER (1824-1895). Son of the romantic novelist of the same name, Alexander Dumas the Younger, a dramatist, offers a striking contrast to his father. He profited by his father's and his own mistakes, for as a youth he had shared in the reckless dissipation of the elder Dumas. Having turned from a life of pleasure, he began to write with serious purpose. In 1848 he won a distinct success with the novel *La dame aux camélias,* which was later dramatized. Under the name *Camille,* it was played for years on the French and the English stage, and is the basis of the popular opera, *La Traviata.*

All of Dumas' plays attempt to unmask the follies and vices of his time. They include *The Money Question, The Prodigal Father,* and *The Wife of Claude.*

DUN'BAR, PAUL LAURENCE (1872-1906). America's best-known Negro poet was Paul Laurence Dunbar. His charming poems of southern cabin life rank him as perhaps the first literary genius of his race in America.

Dunbar was born at Dayton, Ohio, and was educated at the local high school. At first he worked at menial tasks but after a time took up journalism in New York. From there he went to a position on the



EVER-SHIFTING HILLS OF BREEZE-BORNE SANDS
The restless wind creates a surf of sand upon the rolling dunes which it propels.

staff of the Library of Congress at Washington, D. C. Probably the best received of his works are *Poems of Cabin and Field, Candle-Lightin' Time,* and *Lyrics of Love and Laughter*. Many of Dunbar's poems are in the dialect of his people, and all contain a wealth of the humor and sadness of his race.

DUNE. Wind blowing over large areas of loose sand, piles it up around obstacles in forms very like snowdrifts. The sand piles, however, are sometimes 1,000 or more feet high. Such dunes, as they are called, are common in deserts and along sandy coasts and shores. Around the southern end of Lake Michigan there is a long stretch covered with these dunes. They do not form on the west shore of the lake because the prevailing winds, being from the west, blow the sand into the lake.

Sand dunes affect man and his activities in many ways. In deserts they tend to cover the oases, making constant effort necessary to prevent the destruction of the gardens; they make travel difficult by filling and obstructing trails. Valuable farm land, where it adjoins a sandy tract, is often inundated by drifting sand. Forests and even houses are occasionally buried under dunes, although usually the latter may be rescued if it seems worth while. In an open country where there is nothing to prevent, these dunes may travel very rapidly. The wind blows the sand up and over the tops, allowing it to lodge on the leeward side, so that eventually a dune has been entirely moved or is said to have migrated. In some places, grasses and trees are planted and low fences are built for the purpose of checking the advance of dunes.

DU PONT. To the average American, the name Du Pont for more than a century has been a synonym for munitions, gunpowder, dynamite. True, Eleuthère Irénée Du Pont de Nemours was the first manufacturer of gunpowder in America, and the company he founded in 1802 near Wilmington, Del., is still the leader of the American explosives industry. But the present organization manufactures far more than munitions today, for there is scarcely a home in the United States into which its products have not gone.

Millions of packages are wrapped every year in the transparent Du Pont product called cellophane. Du Pont factories turn out many synthetic threads widely used in making such fabrics as rayon, nylon, orlon, and dacron, a substitute for wool. Du Pont lacquers coat automobiles; and Du Pont chemicals keep radiators from freezing in winter. Photographic films and chemicals are an important line. Du Pont plastics are pressed into thousands of industrial products—transparent lampshades, automobile instrument boards, radio cabinets, ashtrays, and shatterproof glass that is not glass at all.

DÜRER, *du'rur,* ALBRECHT (1471-1528). One of the most influential of German artists of the Renaissance, Albrecht Dürer was a noted designer, sculptor, painter, engraver, and inventor. He engraved on both wood and metal, and discovered a method of printing woodcuts in two colors. Dürer was appointed court painter by both Maximilian I and Charles V He was extremely popular with both nobles and common people, and boasted of such friends as Melanchthon, Erasmus, Raphael, and Martin Luther.

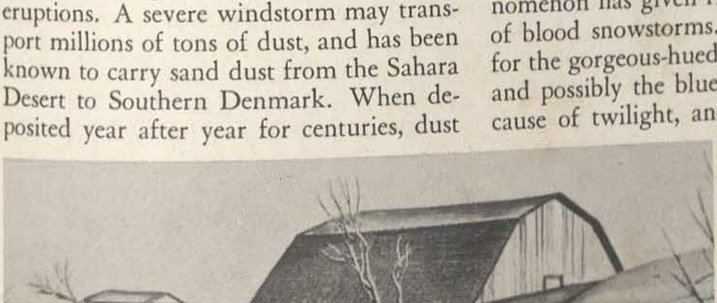
His masterpieces in painting include *Crucifixion, Adoration of the Magi,* and *Adam and Eve.* The figures are strong and individually dignified, a combination of classical naturalness and religious idealism. Notable among his copper and wood engravings are *Fortune, Melancholy,* and *Adam and Eve in Paradise.*

INFLUENTIAL ARTIST

This self-portrait of the master Albrecht Dürer was painted in his twenty-seventh year, 1498.

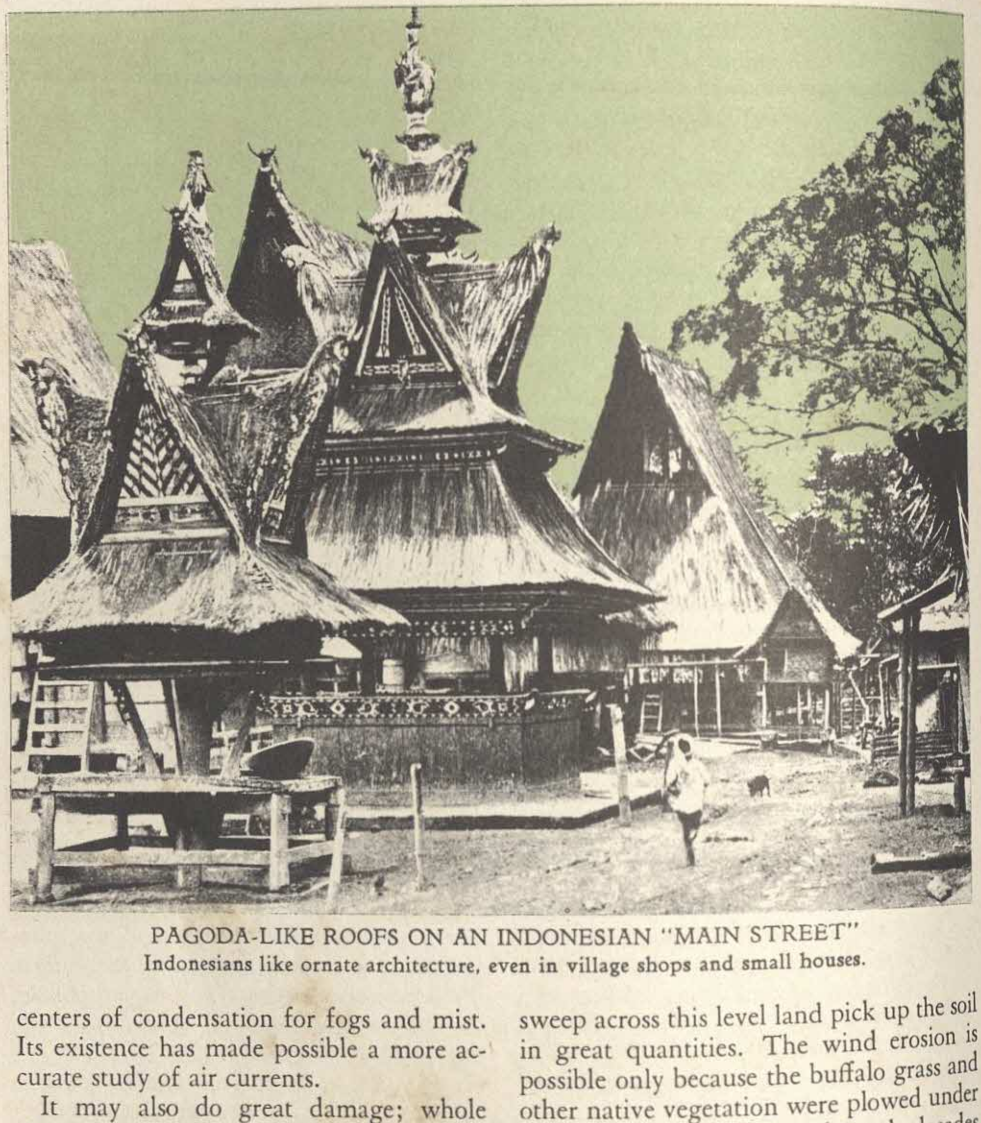
DUST, ATMOSPHERIC. A ray of sunlight entering a darkened room shows the air full of tiny floating particles of solid matter, or dust. Everywhere, except during or just after a heavy rain or snowstorm, the air contains countless numbers of such particles, the proportion varying with location and other conditions. Dust gets into the air from smoke, by the wind's drawing it up from the ground, and from volcanic eruptions. A severe windstorm may transport millions of tons of dust, and has been known to carry sand dust from the Sahara Desert to Southern Denmark. When deposited year after year for centuries, dust forms a very fertile soil called *loess,* which in China reaches in some places a depth of several hundred feet. Every farmer in the world has, on his farm, dust from every country on the globe.

Tiny organisms floating in the air often give snow a reddish tinge, and this phenomenon has given rise to the superstition of blood snowstorms. Dust is responsible for the gorgeous-hued sunsets and sunrises, and possibly the blue of the sky; it is the cause of twilight, and probably furnishes



A GRAY DEATH

A roaring dark cloud swept down upon this peaceful Nebraska farm and completely buried it. Nothing was left but ruin and desolation, and the farmer and his family lost everything. Such tragedies are caused by wind erosion—the lifting of the topsoil by winds. It can be stopped only by proper treatment of the land under cultivation in the West.



PAGODA-LIKE ROOFS ON AN INDONESIAN "MAIN STREET"
Indonesians like ornate architecture, even in village shops and small houses.

centers of condensation for fogs and mist. Its existence has made possible a more accurate study of air currents.

It may also do great damage; whole desert caravans have been buried by it, and fine dust of inflammable material floating in the air, such as is found in flour mills and coal mines, catches fire easily, like finely split kindling, and may cause explosions. As well as being a source of great discomfort, dust may act as a carrier of disease germs.

In what is now known as the "Dust Bowl" of the United States, a large area of the prairie states is subject to severe economic loss from violent dust storms. The strong, prevailing westerly winds which sweep across this level land pick up the soil in great quantities. The wind erosion is possible only because the buffalo grass and other native vegetation were plowed under for boom-time farming in the early decades of the twentieth century. Subsequent cycles of drought have prevented the land, now abandoned to the winds, from restoring its natural system of plant-root anchorage.

DUTCH EAST INDIES. Like a great necklace stretching from the Malay Peninsula to Australia lie the Dutch East Indies. Before the establishment of Indonesia in 1949, this valuable group of islands included Java, Sumatra, Celebes, Riau-Lingga Archipelago, Molucca Islands, Bali, Timor Archipelago, and hundreds of smaller islands, as well as most of Borneo and part of New Guinea. The capital, Jakarta (Batavia), one of the world's large cities, is located on the island of Java. The chief exports of the islands are sugar, rubber, coffee, tea, tobacco, and cinchona bark. The area of the group is about 735,268 square miles and the population, 86,900,000. The Dutch East India Company ruled these possessions from 1602 to 1798, when they were given to The Netherlands. The Japanese occupied the islands from 1942 to 1945. Dutch sovereignty was then restored, but was relinquished over all but Netherlands New Guinea when Indonesia became an independent republic in 1949. See Borneo; Celebes; Indonesia; Java; Moluccas; New Guinea.

DUTCH GUIANA, *ge ah'nah,* See Surinam.

DUTIES. See Customs Duties; Internal Revenue; Tax.

Right, courtesy Cunard-White Star Ltd.
Below, Ewing Galloway

REPUBLIC OF ISLANDS

Indonesia's warm climate and abundant rainfall enable the people to raise enough food for the large population. Right, graceful Balinese girl carries display of fruit. Below, fishermen's bamboo houses in Celebes are built on stilts.

DVORAK, *dvor'zhahk*, ANTON (1841-1904). What lover of music is not familiar with Dvorak's *Symphony from a New World,* which, despite its European texture, embodies strains of American Negro and Indian melodies? Dvorak and Friedrich Smetana are regarded as the two leading Bohemian composers.

Although Dvorak was born at Mühlhausen and trained at Prague and Vienna, the music capitals of Europe, he spent considerable time in England and the United States. For three years, starting in 1892, he was director of the National Conservatory in New York. Dvorak was not a classical composer, but in reflecting the Slavic spirit, his music is fresh and inviting. Among his best-known sacred compositions are *Stabat Mater* and *Requiem Mass.* He also wrote *Humoresque, Songs My Mother Taught Me,* and *Slavonic Dances.*

DWARF. Usually applied to a very small human being, the term *dwarf* properly describes any animal or plant far below the normal size for its kind. In animals, including human beings, this stunting of growth is due to glandular defects. Dwarfed plants are usually small because they are artificially prevented from growing.

In the past, human dwarfs have often been objects of derision, and most of the jesters who amused the kings and nobles of olden times were dwarfs (see COURT FOOL). Several of these unfortunate clowns gained wide reputations. Among them was Jeffery Hudson, the favorite of King Charles I of England. At thirty, he is said to have been only eighteen inches tall, but in later life he grew to a height of forty-five inches. Stanislaus, a Polish king, had a famous dwarf named Bébé, who was thirty-three inches tall. Wybrand Lolkes, of Holland, was just twenty-seven inches tall at the age of sixty.

The most celebrated of all dwarfs was P. T. Barnum's midget, "General Tom Thumb," whose real name was Charles Stratton; he was thirty-one inches tall.

The reason dwarfs became jesters was that they often were extremely witty, since such deformity usually does not affect the mind and may even sharpen the wits. Besides, dwarfs are often perfectly proportioned, whereas giants are frequently stupid and malformed.

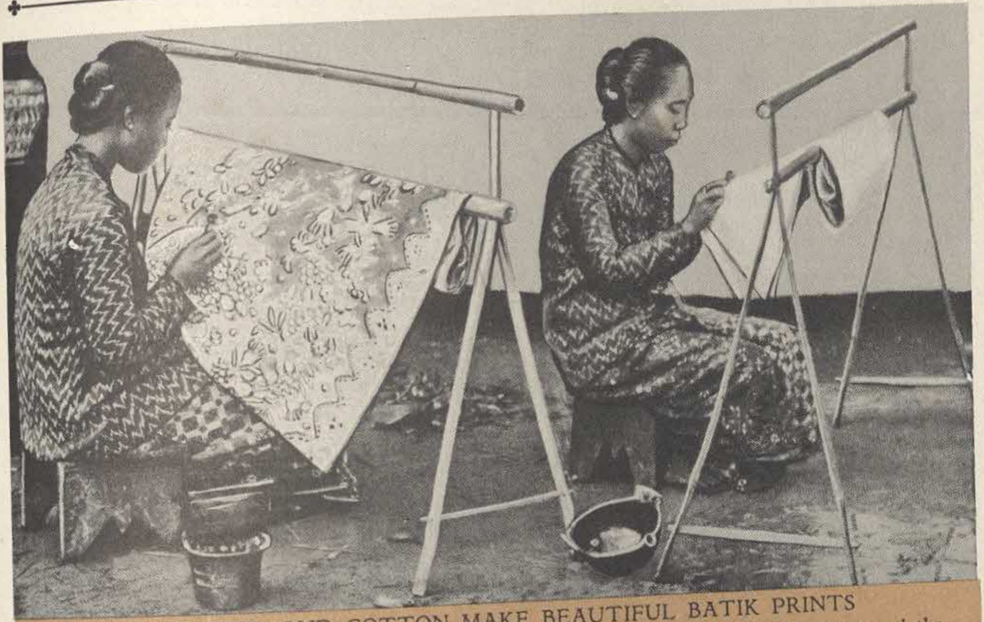
BORNEO HOUSEWIFE

Dyak women, wives of the famed head hunters, are expert weavers and dyers of fabrics.

Several tribes of human dwarfs have been found in Africa. These people are not malformed nor abnormal, but are clans of tiny, well-proportioned men.

DY'AKS. The celebrated "Wild Men of Borneo" probably were Dyaks, who are the natives of the island. The fabled ferocity of the Dyaks is probably due to the fact that they once practiced head-hunting, severing the heads of their defeated enemies for trophies. Their appearance, too, is wild by our standards, and the "Wild Man of Borneo" was a favorite exhibit at circuses and freak shows a few decades ago.

Actually, however, the Dyaks are docile people, living in the interior ot Borneo in a fairly well-developed aboriginal society.



WAX, DYE, AND COTTON MAKE BEAUTIFUL BATIK PRINTS

These Javanese women are expert at Batik. The pattern is laid on the cloth in wax, and the dyes color the uncovered spaces. The wax is removed with boiling water, and there is the print.

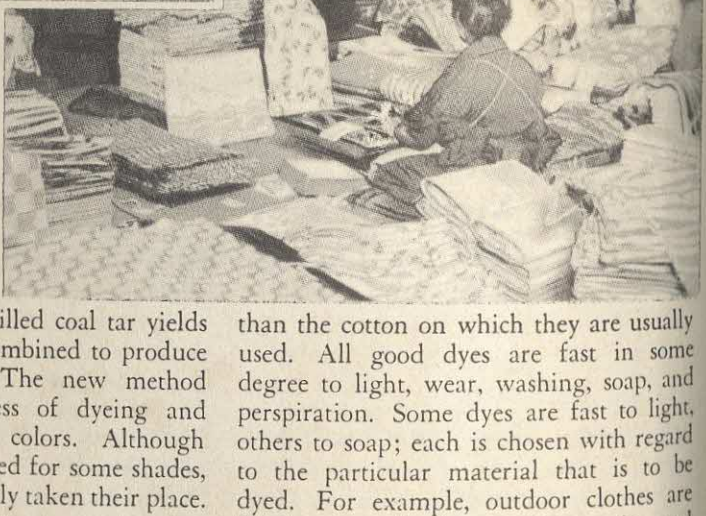
They farm the land and build quite comfortable homes for themselves. These people are not black, but a light, yellowish tan, and are unusually handsome and vigorous. The Dyaks who have come under the influence of the white man have ceased the savage practice of head-hunting.

DYEING, *dī'ing*. It has been said that color has been to the mind of man what salt is to his food. Almost from the beginning of his history, man has attempted to make his clothes and fabrics beautiful by reproducing the vivid colors of nature with the natural dyes made from plants and animals. Color has indeed played a very important part in the development of the mind of man, and everyone from childhood to old age uses color in some form in his daily life.

Beautiful fabrics with the colors still bright have been dug from the ruins of ancient cities, from the tombs of the Pharaohs of Egypt, and from the graves of Peruvian Indians buried more than a thousand years ago. That the use of dyes has long been an established art is shown by the fact that many Oriental rugs that have been used for hundreds of years still show bright colors. The lasting color effects of many of these old fabrics is due not only to the proper combining of colors and methods of dyeing, but also to precious dyes that have always been valuable articles of commerce.

Up to the middle of the nineteenth century, the bark, leaves, and roots of plants, as well as insects and shellfish, have supplied the extracts and juices used to color fabrics and clothing. The walnut, black oak, and logwood were the chief sources for dark colors like brown and dull green. Brilliant blues, scarlets, and reds were obtained from indigo, cochineal, madder root, and tumeric. Fustic, obtained from trees found in South America, was the source of yellow.

The whole art of dyeing was completely changed when William Perkin, an English chemist, discovered in 1856 that a beautiful mauve color could be obtained from the distillation of coal tar. This discovery marked the beginning of a great industry and the production of thousands of individual colors and shades from coal tar.



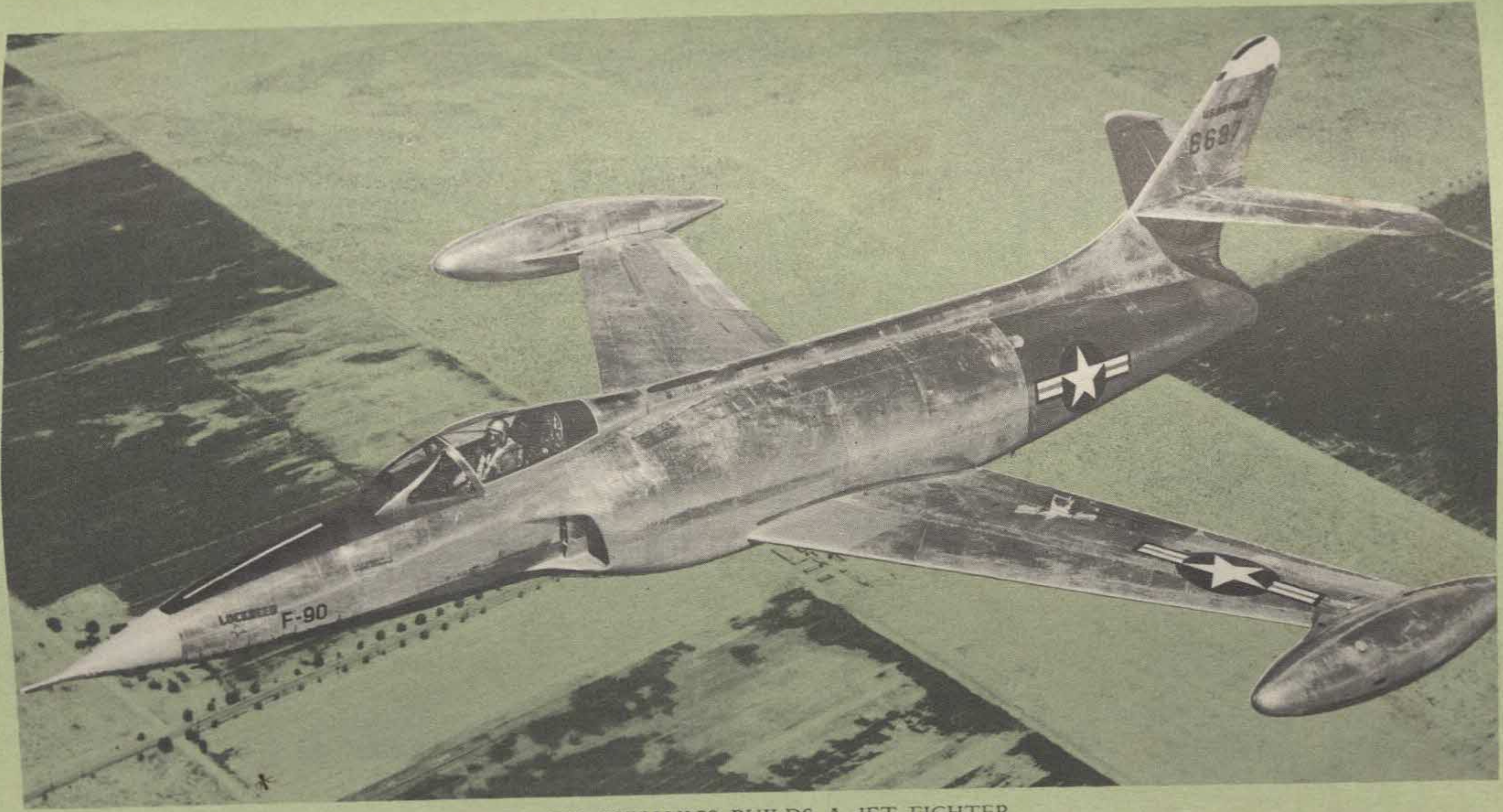
EXPORT WEALTH
Japan is the land of silk, where the technique of dyeing beautiful fabrics is an ancient art. Above, hanging up a dyed piece for drying. Right, finished bolts of cloth in brilliant profusion at the market, the goal of a long and complicated process.

In this process the distilled coal tar yields chemicals which are combined to produce a variety of colors. The new method speeded up the process of dyeing and produced more exact colors. Although natural dyes are still used for some shades, artificial dyes have largely taken their place. See ANILINE; COAL TAR.

Germany, within fifteen years after the discovery of the first artificial dye, became the greatest manufacturer of chemical dyes. German chemists soon developed special dyes for different materials, such as cotton, leather, paper, wool, and silk. Most of the nations of the world depended upon Germany for their dyes; and the United States, despite the fact that the country possessed the largest supply of coal, bought more than eighty per cent of its dyes from Germany. With the coming of the World War, however, the situation was changed. The Allies, unable to get dyes from Germany because of the blockade, began to build up their own dyeing industries. In spite of the fact that the American dye industry developed slowly, it now produces dyes in such quantity and quality that even though trade relations with Germany have long since been restored, it is necessary to import only a small amount of some special dyes.

Fastness of Color. No dye has yet been developed which is fast under all conditions. The modern *vat* dyes seem to be the most permanent and will last longer than the cotton on which they are usually used. All good dyes are fast in some degree to light, wear, washing, soap, and perspiration. Some dyes are fast to light, others to soap; each is chosen with regard to the particular material that is to be dyed. For example, outdoor clothes are dyed to remain fast to light, rain, and perspiration; and curtains are dyed fast to light and washing. Fabrics that are not made to last a long time are inexpensively dyed. In order to get the best results, therefore, every sort of material has to be dyed with special reference to its intended purpose.

The Process of Dyeing. Small packages of dyes are sold on the market today to be used in home dyeing. They come in powdered, soap, or flake form, and directions for their use are printed on the pack-



APPLIED DYNAMICS BUILDS A JET FIGHTER

This fast Air Force plane is a product of increased knowledge of dynamics, which deals with the effects of force on matter. The ship's wing is designed to carry the weight of the plane in flight, as well as to support its own weight when the plane is on the ground. In addition, it is swept back so that it will not "stall out" (lose its lifting force) at low speeds. Aerodynamically "clean," the ship gives top performance.

age. Although most of the package dyes are *direct dyes* which will color cotton and wool at the same time, some are made for only particular kinds of fabrics. The one designed for wool cloth is an *acid* dye which is used only on animal fibers. Most of these dyes contain a *mordant,* which is a substance, such as alum, that gives bright and lasting qualities to the dyes.

DYNAMICS, *di nam'iks.* To build a great bridge, construct a high-speed streamline train, or to test the physical properties of substances requires a knowledge of the laws of force. The study of that force which makes wheels move and enables bridges to stand up under heavy loads is called *dynamics,* a science which springs from the epochal discoveries of Sir Isaac Newton.

Newton established three cardinal principles that form the foundation of dynamics. These are the *laws of motion.* Newton found (1) that a body in motion tends to move in a straight line, and that when it is at rest, it remains at rest, unless some force acts upon it; (2) that the rate of change in the momentum of a body is proportional to the force acting upon it and to the length of time during which it acts, and it is in the same direction as the force; (3) that there is a reaction in the opposite direction equal to the action of a force.

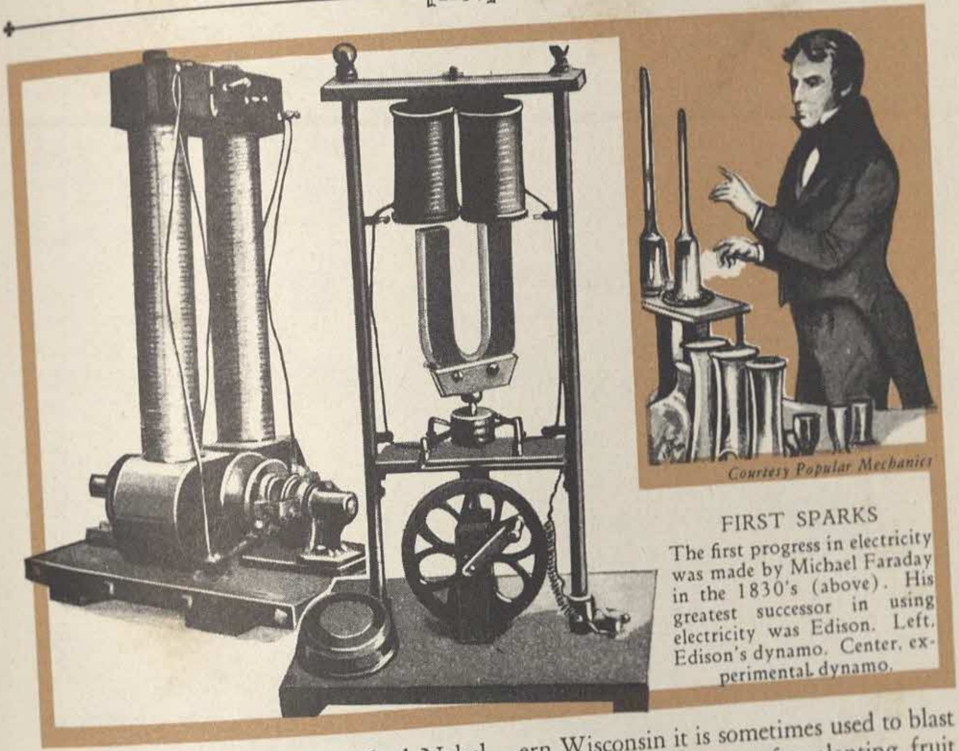
From these principles, dynamics branches into two divisions: one, called *statics,* deals with forces which counteract one another and keep a body at rest; the other, called *kinetics,* is concerned with force that causes bodies to move, such as the explosions in the cylinders of a gasoline motor or the revolutions of a turbine wheel in a great electric power dam.

DY'NAMITE. In places where rock, clay, or hard ground makes digging both difficult and expensive, it has become a common practice to use dynamite for blasting the stubborn material. Usually made by soaking wood pulp or guncotton in nitroglycerine, dynamite is a powerful and useful explosive, but a very dangerous one.

Courtesy Popular Mechanics (right)

LETTING DYNAMITE DO THE WORK

Without dynamite, handling materials on a large scale would be difficult. Dynamite is a peacetime explosive.



Courtesy Popular Mechanics

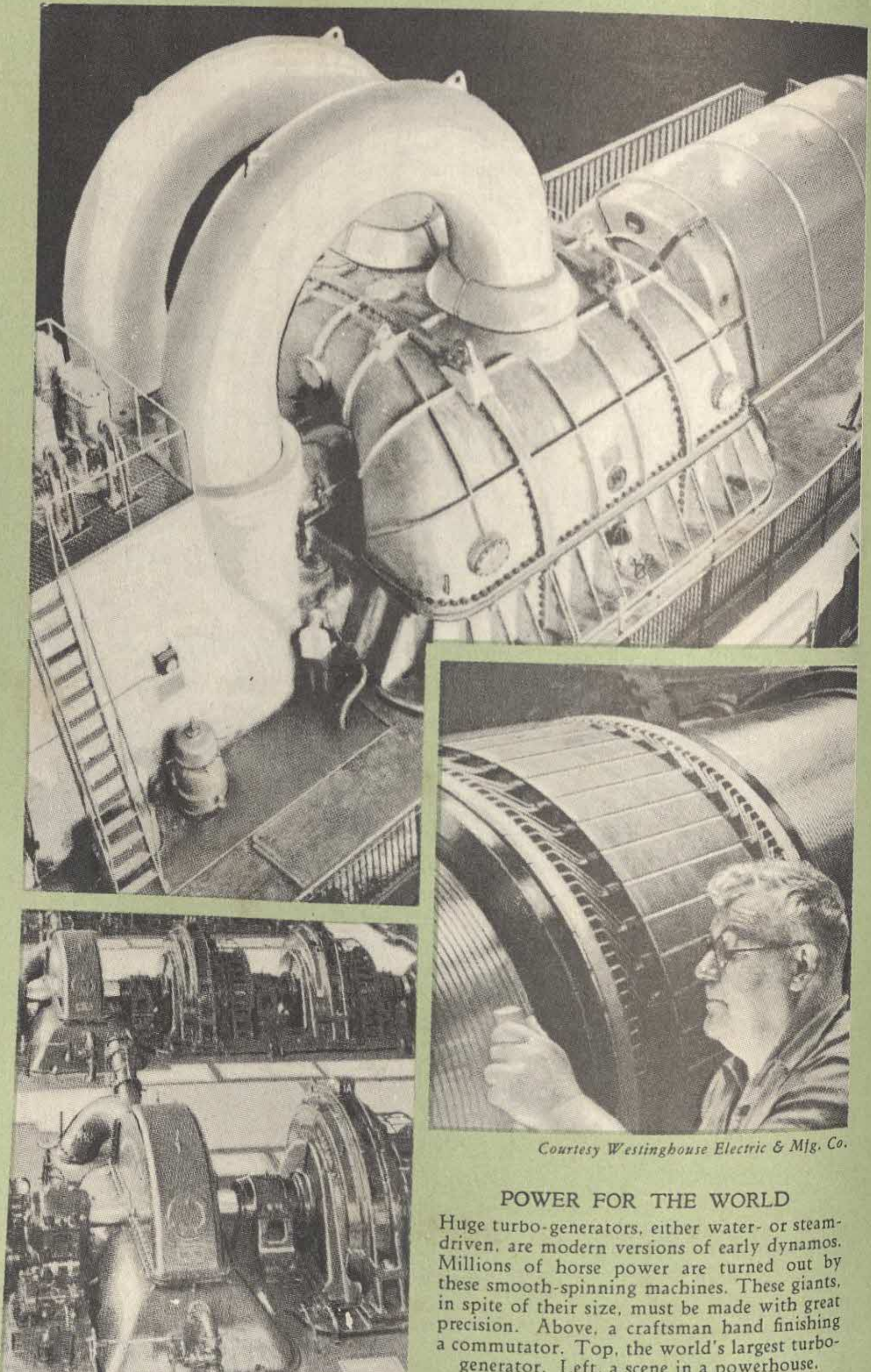
FIRST SPARKS
The first progress in electricity was made by Michael Faraday in the 1830's (above). His greatest successor in using electricity was Edison. Left, Edison's dynamo. Center, experimental dynamo.

It was invented in 1866 by Alfred Nobel (originator of the famous Nobel prizes). Its strength is regulated by the amount of nitroglycerine it contains, usually forty per cent, fifty per cent, or sixty per cent. Not easily exploded unless given a sudden jolt, dynamite is usually fired with a blasting cap, or detonator.

Dynamite is made up into sticks about eight inches long and one and one-fourth inches in diameter. To be effective, dynamite must be packed in tightly so that the exploding gases will have the greatest possible force. It usually explodes in a downward direction. Although dynamite is many times stronger than gunpowder, there are today several explosives that greatly exceed it in power.

Properly handled, dynamite is one of man's most useful servants. Its greatest use is in the blasting of rock in great engineering projects, as in constructing tunnels through mountains, building bridges, and blasting ore in mines. On farms, it is employed to rid land of stumps, and in Northern Wisconsin it is sometimes used to blast holes in the limestone for planting fruit trees. In digging deep wells and ditches, it has no equal. Dynamite is often brought into service by contractors to remove big stones and to loosen hard clay in the construction of large buildings. See BLASTING; EXPLOSIVES.

DYNAMO, *di'na mo,* or **DYNAMO ELECTRIC MACHINE.** The electric current that lights your home, runs the streetcars, operates your radio, and performs countless other tasks is generated in a power-driven machine once called a dynamo but now generally known as an electric generator. Usually propelled by steam or water power, generators are of two types, alternating current (A.C.) and direct current (D.C.). If the current flows first in one direction, then in the other, it is alternating; but if it flows continually in one direction, it is direct. Electricity is usually generated as alternating current. However, storage batteries give off direct current and can be charged only by direct



Courtesy Westinghouse Electric & Mfg. Co.

POWER FOR THE WORLD

Huge turbo-generators, either water- or steam-driven, are modern versions of early dynamos. Millions of horse power are turned out by these smooth-spinning machines. These giants, in spite of their size, must be made with great precision. Above, a craftsman hand finishing a commutator. Top, the world's largest turbo-generator. Left, a scene in a powerhouse.

current. Electric motors are usually built to employ one type of current or the other.

Alternating- and direct-current dynamos are very much alike in general principle. In both, there are coils of wire rotating within a magnetic field and cutting the magnetic lines of force. This wire system is the *armature*. The power generated depends upon the speed of the dynamo, the strength of the magnets, and the number of turns of wire in the rotating coils.

Alternating-Current Dynamo. The simplest possible dynamo would consist of a single coil of wire turning around between the poles of an ordinary "horseshoe" magnet. As one side of the coil approaches the north pole of the magnet and the other approaches the south pole, a current begins to flow. The closer the coil approaches the magnet, the greater the current. Then, as the coil turns away, the current lessens.

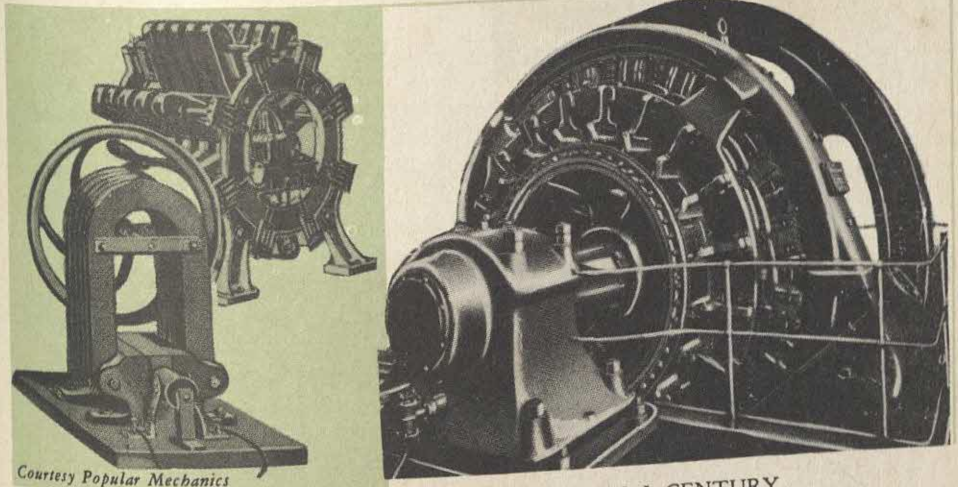
As the first side approaches the south pole, current again flows, but in the opposite direction. Thus, as the coil turns, the current constantly reverses itself. Fastened to each end of the coil is a plain metal ring which turns with the coil. As these rings rotate, springs, called brushes, rest upon them and pick up the current, sending it out on the line to be employed as power.

Actually, the armatures in alternating-current dynamos have not one coil, but many, arranged in pairs. Instead of a revolving armature in a stationary field, there may be a revolving magnet in a stationary armature.

Direct-Current Dynamo. The chief difference between the alternating- and the direct-current dynamo is in the rings. In a direct-current dynamo, the rings are split into two or more parts and are called *commutators*. They are so wired that the brushes pick up only the current flowing in one direction, thus making the current direct and not reversing, or alternating.

Dynamo and Motor. The construction of a dynamo and of an electric motor can be the same. Any motor, if rotated, will give off current; and any dynamo, if current is fed into it, can be used as a motor.

DYNE. Force is measured in the metric system by a very small unit called the dyne. Representing about 1/980 of the pull of gravity on a gram of matter, the dyne is the amount of force which, when acting on a gram of matter for one second, will cause a change of one centimeter per second in its velocity. The *megadyne* is equal to 1,000,000 dynes and is often used instead of the dyne. See DYNAMICS.



Courtesy Popular Mechanics

SCIENCE HAS COME A LONG WAY IN A CENTURY

The earliest hand-driven dynamos were little more than curiosities (left). Today, the production of electricity by great generators (right) is a leading industry.

E.

The fifth letter of the alphabet, *E* is used most often in English words. The Phoenicians wrote the letter like this, 𐤄 . Considering the fact that they wrote from right to left, it may easily be seen that their letter for *E* was really quite similar to ours. At first the Greeks wrote the letter much as did the Phoenicians, from whom they learned the alphabet. But in time, the Greeks learned to write from left to right, as we do; and they turned *E* around and wrote it Ε or Ɛ . The Romans straightened the letter and wrote it *E*.

EAGLE. The powerful eagle, with majestic mien and great spreading wings that carry it to terrifying heights in the sky, has been since ancient times a symbol of strength and majesty. For centuries, poets have written odes to this "King of Birds." Although in some respects the eagle justly deserves its reputation, it does not always conduct itself with royal grace.

Related to the hawks and falcons, the eagle is strictly a bird of prey. It frequently feasts on rabbits and other small wild animals and swoops down on farmyards to carry away chickens and even lambs to its nest, or eyrie. Like the condor, the eagle eats dead and decaying flesh, often picking up dead fish found along the shores of lakes and ocean. It is a thief, too, and frequently robs other birds of fish which they have caught.

The eagle builds its nest on crags on rocky ledges, or in the tops of high trees, usually out of the reach of man. The nests are very large, often six feet wide, and are coarsely built of sticks. Only two or three dull-colored eggs are laid at a time.

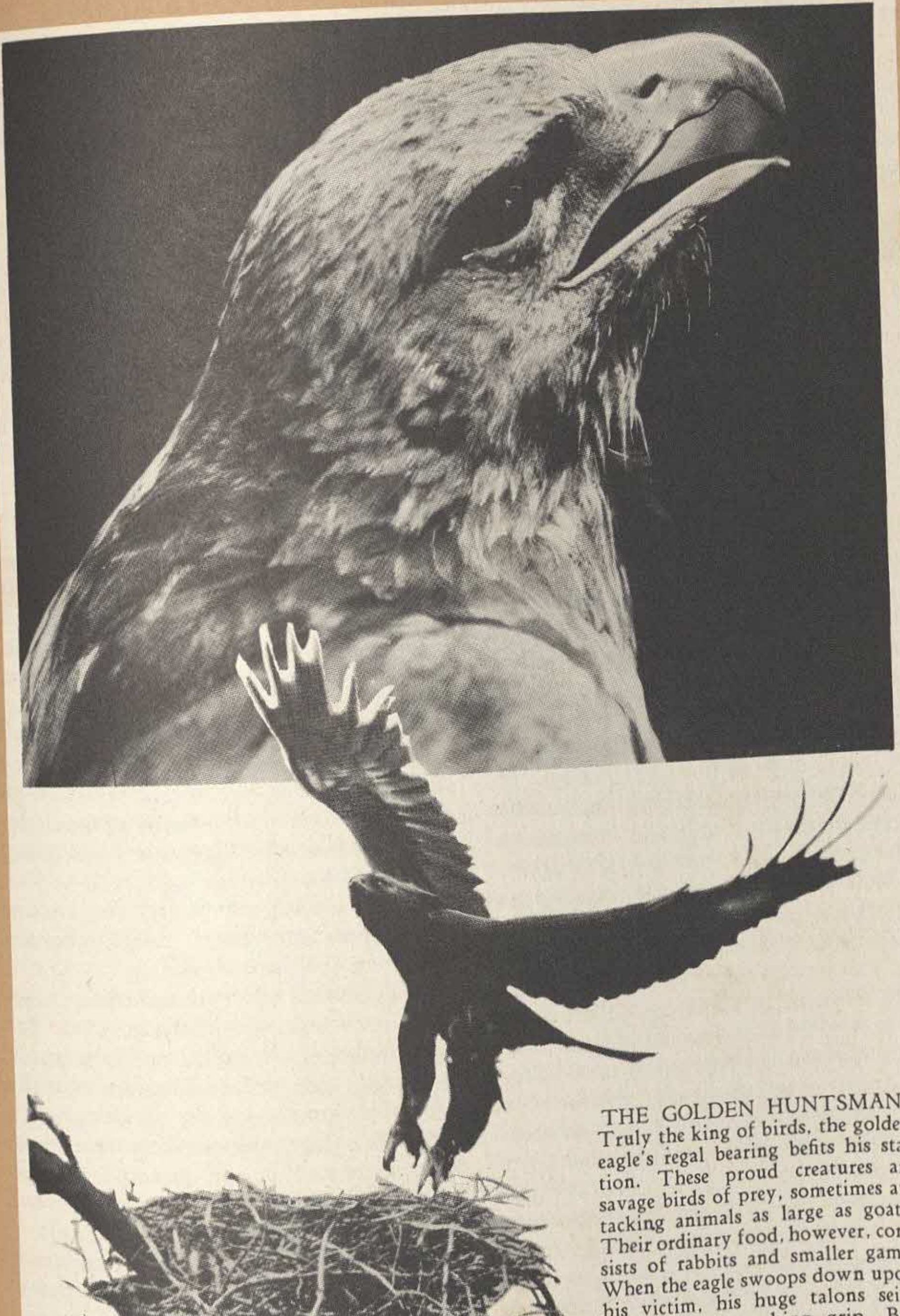
The eagle has a long, powerful bill with the upper part curved sharply over the lower; its wings stretch to the top of the tail, and its legs are feathered to the toes. Eagles may possibly live 100 years.

The *golden* eagle is found in the United States, although it is more common in Europe, Asia, and Northern Africa. It has a wingspread of over six feet and measures three feet from the beak to the end of the tail. The body is brown, and the feathers of the neck and head are pointed and have a golden hue. The golden eagle feeds mostly on land animals.

The national emblem of the United States is the *bald* eagle, which takes its name from the fact that the neck and head are white. It is a sea eagle and feeds mostly upon fish. Somewhat smaller than the golden species, the *bald* eagle is a handsome bird with an air of great majesty, especially when flying.

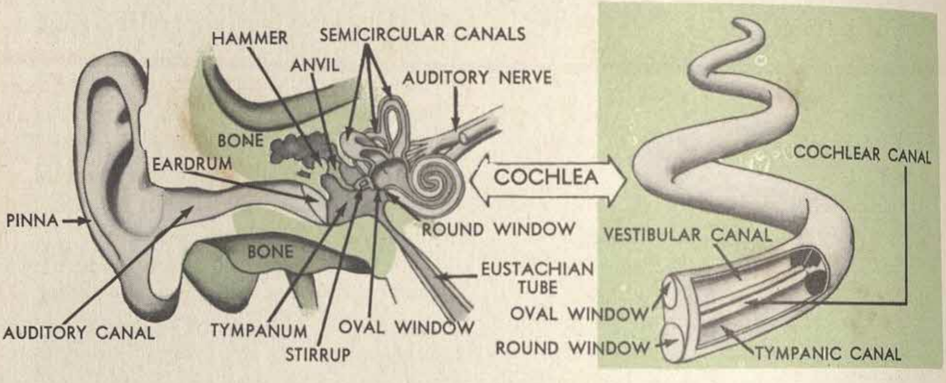
EAGLE, The. From early times the eagle has been used as a military and national emblem. It was first employed for this purpose in Persia, where it was carried on the top of a spear. The Romans also used it as an emblem, adopting it in 104 B. C. Their symbolic eagle was about the size of a pigeon and was made of gold or silver. The bald eagle, with spreading wings, was adopted as the national emblem of the United States in 1785.

EAR. Can you imagine a world without any sound whatever? If you can, you will realize what life must be like for those who



THE GOLDEN HUNTSMAN

Truly the king of birds, the golden eagle's regal bearing befits his station. These proud creatures are savage birds of prey, sometimes attacking animals as large as goats. Their ordinary food, however, consists of rabbits and smaller game. When the eagle swoops down upon his victim, his huge talons seize with a bone-crushing grip. But there is not any truth in tales of eagles abducting children, since the birds can lift little more than five pounds. Top, the royal head. Left, the eagle and his nest, or *eyrie*.



THE PARTS OF THE EAR
At the right is the cochlea, which contains the actual organ of hearing.

are so unfortunate as to lose their sense of hearing. The ear, the organ of hearing, is a marvelous mechanism; and to lose its use is one of the most tragic handicaps a person can have. For to the deaf are denied the joys of friendly voices, of music, of the radio, of all the sounds of nature. To the deaf, the world is a vast silence. Because proper care of the ears often prevents deafness, it is important to understand the mechanism which makes hearing possible.

In all the higher orders of animals and in man, the ear is divided into three parts: the external ear, the middle ear, and the internal ear.

The External Ear. The external ear, or *concha,* has two parts: the outer, called the *pinna,* which is visible on the side of the head; and the *auditory meatus,* a canal which extends inward to the middle ear. The pinna is usually immovable in man. The human external ear consists of cartilage, skin, and a thin, muscular coat. It is constructed so as to direct sound waves into the auditory canal, which leads to the *tympanic membrane,* commonly called the eardrum. The eardrum is a circular membrane stretching across the inner end of the auditory canal and separating the middle from the external ear. It contains several muscles, some of which are fastened to the bones of the middle ear. The inner surface of the eardrum is lined with a mucous membrane.

The Middle Ear. The middle ear, or *tympanum,* is located in the temporal bone of the head. From its inner side a small passage, known as the *Eustachian tube,* extends to an opening at the back of the nose. On the bony wall of the tympanum are two openings that lead to the internal ear. The middle ear is filled with air which enters through the Eustachian tube and presses on the eardrum from the external ear. In this way the air pressure in the middle ear usually is kept constant. Sometimes when a person goes up or down in an elevator in a tall building or in an airplane, the sudden change of air pressure gives him a feeling of dizziness or results in buzzing sounds in the ears.

The middle ear contains three bones, called *ossicles,* which, because of their strange shape, are called the *hammer,* the *anvil,* and the *stirrup.* The handle of the hammer is attached to the eardrum, and its head fits into the concave surface of the anvil. One end of the stirrup is attached to the anvil and the other end to the vestibule of the internal ear.

Internal Ear. The internal ear is very complicated in structure and is the part of the ear most closely associated with hearing. It includes the *cochlea, semicircular canals, utriculus,* and *sacculus,* all of which are essentially membranous sacs embedded in the temporal bone. The semicircular canals, utriculus, and sacculus are concerned mainly with equilibrium, while the cochlea contains the receptors for hearing. The cochlea is a coiled structure resembling a snail shell. If it is uncoiled and stretched out, it is found to consist of three fluid-filled canals that taper to a point at the far end. The uppermost of the three canals is the *vestibular canal,* and the lower is the *tympanic canal.* Both open into the middle ear, the openings being covered by membranes; the membrane of the vestibular canal, known as the *oval window,* is in contact with the bony stirrup. Between the vestibular and tympanic canals lies the *cochlear canal.* This contains the *organ of Corti,* which enables us to hear. This structure consists of many hair cells resting on the membranous partition (*basilar membrane*) that separates the cochlear and tympanic canals. Directly above the hair cells is the *tectorial membrane.*

How We Hear. Sound waves picked up by the pinna pass through the auditory canal to the eardrum, which vibrates. The vibrations are carried by the middle-ear bones to the oval window, which also vibrates and causes the fluid in the vestibular and tympanic canals to move, vibrating the basilar membrane. When the basilar membrane vibrates, the hair cells are stimulated by being brushed against the tectorial membrane. Carried to the auditory center in the brain by nerve fibers connected to the hair cells, the impulses resulting from this stimulation are translated into sounds.

Because the ear is so delicately constructed, it should be carefully protected. Hearing may be destroyed or impaired by injury to the auditory nerve or to the hearing center of the brain; or the sensory nerves and their end organs may be injured by disease or accident, with the result that hearing is affected. Care should be taken of the ear at all times, and treatment should begin immediately whenever there is a sign of trouble. See DEAF AND DUMB.

EARL, *url.* All English titles of nobility once meant that the holder was the ruler of some division of the country. An earl was originally a noble in charge of one of the four sections of England in the Middle Ages. Now the title of earl is only honorary. The king can bestow this rank on anyone who has achieved distinction, and many outstanding statesmen have been thus raised to the nobility. An earl ranks below a marquis and above a viscount. The title corresponds to the French *comte,* or count, and for this reason an earl's wife is called *countess.*

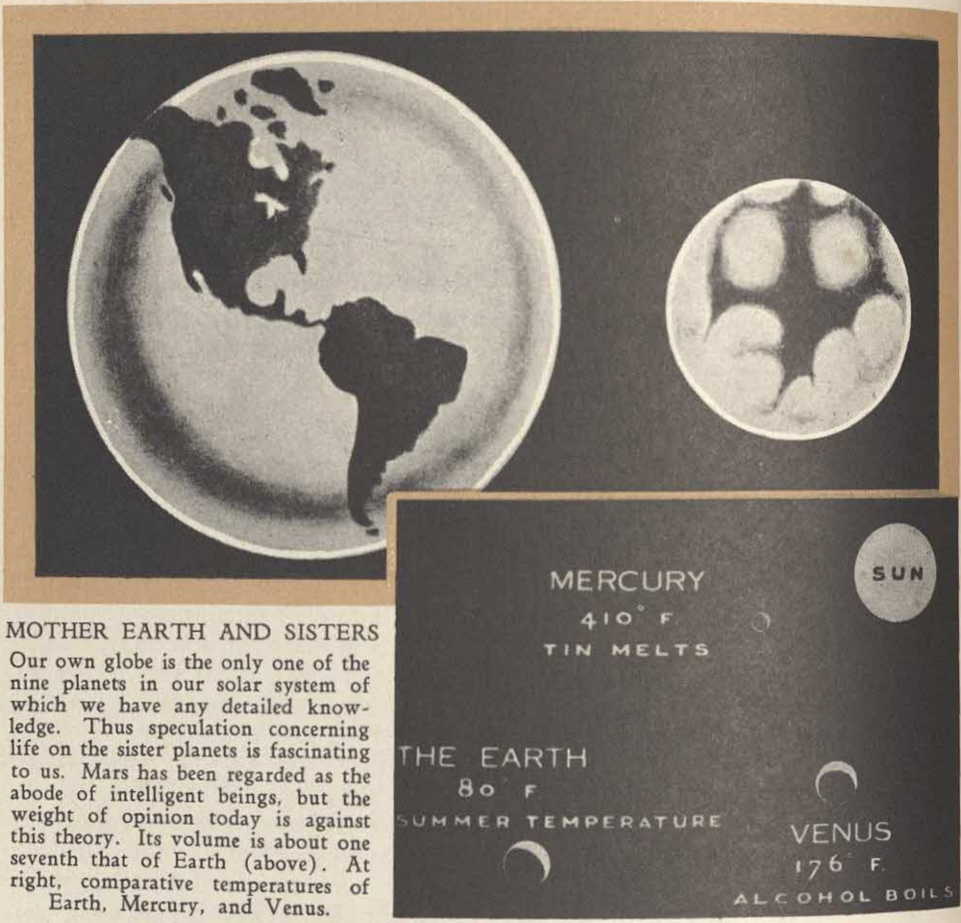
EARTH, *urth.* If we could journey to the moon, the biggest thing we should see in the sky would be the earth. It would appear spherical, just as the moon looks when it is full, and the continents and oceans would be easily distinguished through the light, filmy haze of atmosphere which surrounds the planet.

Composed of the atmosphere (air), hydrosphere (water), and the lithosphere (land), the earth is one of the smaller planets in the solar system, ranking fifth among the nine revolving about the sun. It is less than 25,000 miles in circumference, and has a diameter of less than 8,000 miles. Only Mercury and Venus are nearer the sun, making the temperature on earth higher than that on the more distant planets and, of course, creating a shorter year than on Mars, Jupiter, Saturn, Neptune, Uranus, or Pluto.

The earth's area is 196,950,000 square miles, of which 139,440,000 are water and 57,510,000 land. Its weight is approximately 6,592,000,000,000,000,000,000 tons, not counting the atmosphere.

Even though the earth would appear to be a huge ball when seen from the moon, it is actually not perfectly round. The surface at the Poles is slightly flattened, making the diameter from north to south 7,899.9 miles, 26.7 miles less than the diameter at the equator.

For purposes of measurement, man has divided the earth into sections by horizontal and vertical lines. All the vertical lines, called *meridians,* meet at the Poles, like the bars on a spherical bird cage, and denote the *longitude,* or distance east and west of Greenwich, England. There are 180 degrees of longitude, east and west, the 0-line running through Greenwich and the



MOTHER EARTH AND SISTERS

Our own globe is the only one of the nine planets in our solar system of which we have any detailed knowledge. Thus speculation concerning life on the sister planets is fascinating to us. Mars has been regarded as the abode of intelligent beings, but the weight of opinion today is against this theory. Its volume is about one seventh that of Earth (above). At right, comparative temperatures of Earth, Mercury, and Venus.

180-degree line extending through the Pacific Ocean. Horizontal lines are called *parallels of latitude,* extending parallel to the equator. There are 90 degrees of latitude on either side of the equator; they divide the world into zones called Arctic and Antarctic, North Temperate and South Temperate, and Torrid. Near each geographic Pole is a magnetic pole which governs the actions of compasses.

In addition to revolving around the sun once every 365 days, 6 hours, 9 minutes and 9½ seconds, the earth makes a complete rotation on its own axis in 23 hours, 56 minutes, and 4⅒ seconds. The axis is inclined at an angle of 23½ degrees.

The population of the earth is approximately two billion people, of whom nearly half live on the continent of Asia. The highest point on the earth's surface is Mount Everest in the Himalaya Mountains, 29,141 feet. The lowest depth is about 34,440 feet below the surface of the sea; this spot is between the Japanese and Philippine Islands.

Scientists have engaged in considerable speculation concerning the earth's origin and interior. One theory of the earth's beginning, estimated to be two billion years ago, is that it formed by the cooling of a large mass of swirling gas. Another is that numerous small bodies called *planetesimals* collected and formed a compact mass which gradually became the earth.

Although the surface has been penetrated very little, there is definite proof that the interior of the earth is much hotter than the exterior. Volcanoes erupt masses

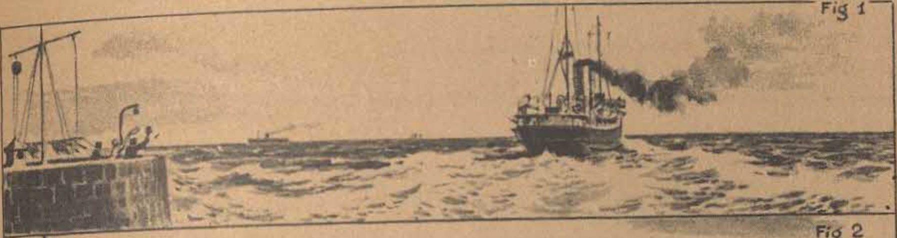


Fig 1

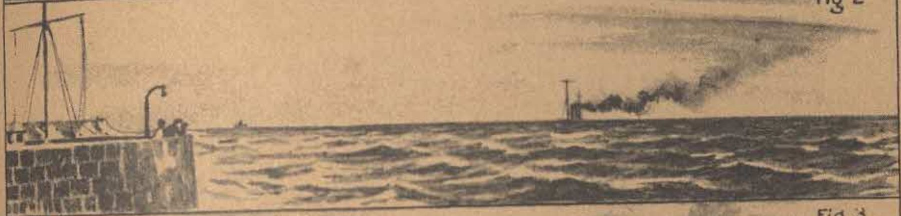


Fig 2

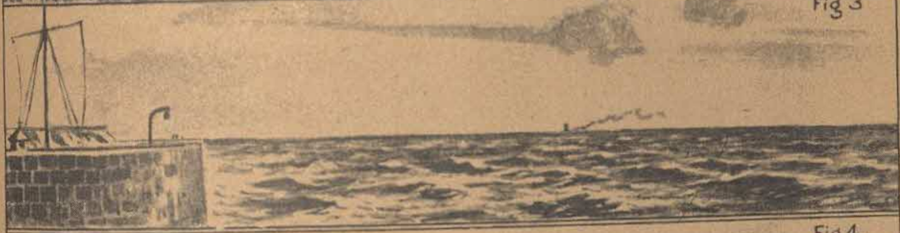


Fig 3

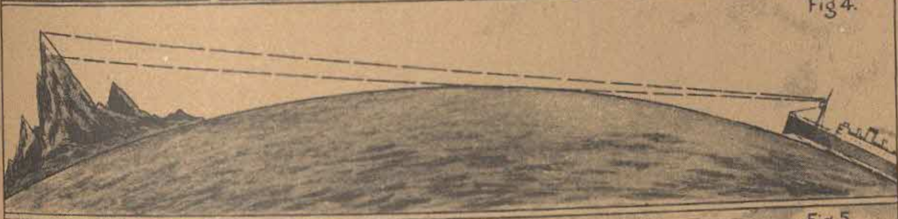


Fig 4.

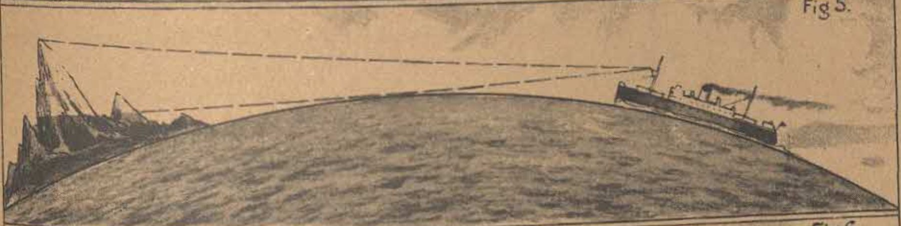


Fig 5.

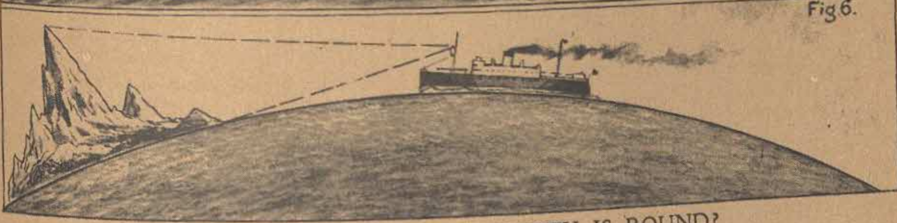


Fig 6.

HOW DO WE KNOW THE EARTH IS ROUND?

There are several proofs of the fact that the earth is a globe, but perhaps the simplest is the disappearance of a ship from the view of an observer. As we watch the vessel steam toward the horizon (Fig. 1), we see that first its hull disappears, leaving only the masts and funnels visible (Fig. 2). Finally it goes out of sight completely (Fig. 3). But if we stand on higher ground, we can still see the ship. Figs. 4, 5, and 6 show what happens. A man on the mountain could see the whole ship before a man on the shore would even see the masts. It works both ways. Those aboard the ship see the top of the mountain first. If the earth were not round, we could see great distances in clear air.

of molten substances (called *magma*) which originate in the interior, indicating an intense heat below the surface. We also know from deep mines and drilling that the temperature increases as we proceed downward.

But what is this hot interior? Is it solid, liquid, or gas? No one really knows, but the generally accepted theory is that the interior of the earth is plastic, kept so by the tremendous pressure of overlying rocks. Parts of the interior can be changed to liquid when the pressure is momentarily removed by movements in the earth's crust. This liquid escapes through volcanoes. Sometimes water seeps through to the interior, resulting in such marvels as geysers and hot springs.

For additional information, consult the following articles:

Antarctic Circle
Arctic Circle
Astronomy
Atmosphere
Chart
Climate
Continent
Day
Earth Currents
Ecliptic
Equator
Equinox
Geography
Geology
Gravitation
Hemisphere
Hydrography
International Date Line
Latitude
Longitude and Time
Magnetic Equator
Map
Meridian
Moon
Nebular Hypothesis
Ocean or Sea
Physical Geography
Planet
Pole
Solstice
Standard Time
Stratosphere
Sun
Tides
Tropics
Troposphere
Weather Bureau
Zone

EARTH CURRENTS. Mystery surrounds the nature of electrical currents in the earth that seem to come from nowhere but cause constant trouble in telegraph and cable communication. These currents pass through the earth in every direction and at varying degrees of strength. Scientists are of the opinion that the brilliant and colorful northern lights, the aurora borealis, and the strange sunspots that come and go on the face of the sun have something to do with earth currents; but so far there has been little definite information concerning their origin. See Aurora Borealis.

EARTHENWARE. See Dishes; Pottery.

EARTH'QUAKE. The trembling felt in the ground as a train or heavily loaded truck on a pavement goes by, is a slight earthquake. However, most people when speaking of earthquakes have in mind only those tremblings of the earth's crust not caused by man. There are many minor causes which may produce slight shocks—such as an avalanche, large rock masses falling over a cliff, as at Niagara Falls, the dropping of the roof of a cavern, or a volcanic eruption.

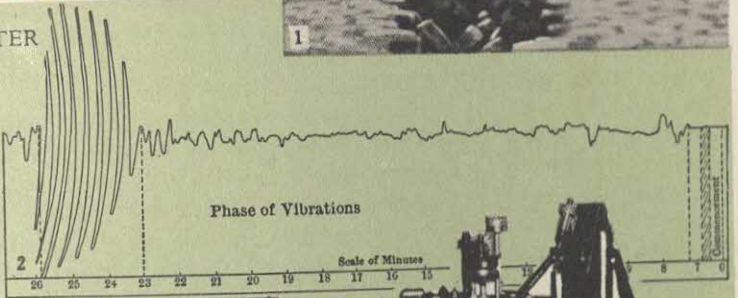
However, the great earthquakes are due in the main to only one cause—the fracturing and slipping upon one another of large rock masses of the earth's crust (see Fault). As the earth contracts, the crust constantly must readjust itself to fit a smaller interior, and where there is a weak place, the rocks break and move to relieve the strain. Often the actual movement at one time is small, a few inches or even a fraction of an inch, but it is so sudden that the effects at the surface are very disastrous. The effect may be illustrated by laying a marble on a table, then striking the table top a sharp blow with a hammer from underneath. The table top moves but little, though the marble may bound several inches into the air.

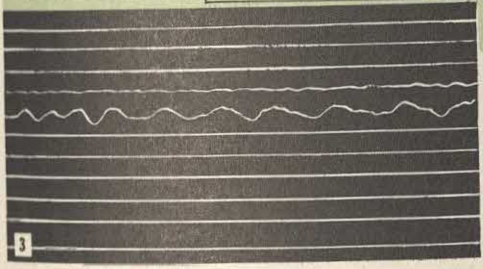
The San Francisco earthquake of April 18, 1906, was due to renewed movement along an old crack for a distance of 250 miles; the horizontal movement varied from eight to twenty feet; the vertical movement, from one to five feet.

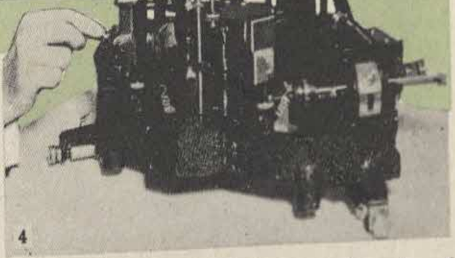
When earthquakes occur on the coast or beneath the sea, great sea waves may be produced. These travel across the ocean at tremendous speeds and may do great damage on low coasts. After the famous Lisbon shock of 1755, the water first receded, leaving the harbor bare; then a sixty-foot wave returned and, overwhelming the city, destroyed such parts as the original earthquake had left.

Earthquakes occur much more frequently in some parts of the world than in others. The regions of greatest activity lie along a vast belt or a series of belts. The danger zone may be traced along the west coast of South America, through Central America and the Caribbean area, and north along North America's Pacific coast. It swings through the Aleutian Islands to Asia, covers eastern and southeastern Asia and nearby islands, and continues westward to the Mediterranean and southern Europe.

TRACKING DISASTER
Sensitive seismographs (4) record the slightest quake, "describe" huge ones accurately. (1) Quake fissure. (2) Record of a bad shock. (3) Record of the Japanese earthquake of 1923, worst in history.







Earthquakes are of great public interest because of the destruction of life and property which they often cause. Undersea earthquakes often break cables and kill immense numbers of fish. Landslides and rapid increase in glacial movement may result from shocks. The shock which centered at Messina, Sicily, in 1908, often called the world's most cruel earthquake, was estimated to have caused the deaths of about 76,000 people. Usually the major part of the loss is due to falling buildings. In San Francisco the crustal movements broke the water mains, so that the fire which broke out raged unchecked. Earthquake and fire killed about 500 people and caused a loss of $500,000,000.

In the Lisbon earthquake the number of persons drowned by the great sea wave, sixty feet in height, is estimated at 40,000 to 60,000. The great Japan earthquake of 1923, with the accompanying tidal wave and fire, caused an estimated loss of 100,000 killed. At least as many more were injured; the property loss was hundreds of millions of dollars. Since that time, serious earthquakes have caused severe losses in various parts of the world.

EARTH'WORM, or AN'GLEWORM. After a heavy rain, we sometimes find so many earthworms on the ground that people say, "It rained worms." Of course, the rain simply forces them to come to the surface.

Earthworms are true worms with long cylindrical bodies which seem to be made up of sections, or segments. The size and shape of these sections may change to help the animals move. Movement is assisted by short bristle-like structures arranged in two double rows along the underside. Anyone may feel these by running a finger along the underside of a worm.

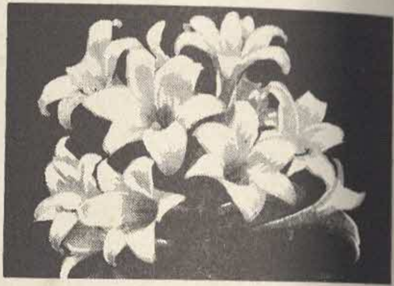
Earthworms have mouths at the forward and, usually, larger end. The mouths have lips, but no teeth. The worms take dirt and plant material into their bodies and come to the surface of the earth when this is ready to leave the body. In this way they help mix surface soil and the soil beneath. They also do a great deal of good by making it easy for air and water to get to the underground parts of plants. They spend the winter deep in the earth.

EASTER. In the spring of the year comes Easter, the day on which Christians commemorate the resurrection of Christ. The earliest Christians followed the Jewish calendar, and in the Eastern church Easter was celebrated on the day of the Jewish Passover. From pre-Christian times it was long the custom of our European ancestors to celebrate the world's awakening after a long winter's sleep.

That is how it happens that our name for Easter comes from the name of the Saxon goddess of spring, and the name in most other lands is connected with the Hebrew word for "passover." It is also the explanation of the fact that Easter is on a different day each year, in Western lands falling on the Sunday after the first full moon of spring.

EASTER LILY. One variety of Japanese lily, with a long, large trumpet-shaped flower, the Bermuda lily is potted and displayed in homes and churches at Easter time. Various types of Easter lilies are forced to bloom at Easter time. See LILY.

EAST INDIA COMPANY. Formed in 1590 in order to bring the spices, silks, and other rich products of the Orient to England, the East India Company was granted its first charter in 1600 by Queen Elizabeth. The charter gave the company a monopoly of trade in India, China, and the East Indies for fifteen years. Trading rights were made perpetual when the charter was renewed by James I in 1609, but the crown reserved the right to cancel them with three years' notice.



EASTER'S LOVELY SYMBOL

The East India Company soon grew very rich and became so important in English commerce that it was granted the power to confiscate the ships and goods of contraband traders operating within its territory. The political power it held gave the company the right to rule oppressively in India; consequently, in 1784, a Board of Control was appointed to supervise all except the commercial acts of the company.

When the charter was renewed in 1813, the company's trading monopoly was restricted to China, and trade with India was thrown open to all British subjects. There was great opposition to the company's political and trading privileges when its charter was again renewed in 1834. In 1858 the Crown took over the right of governing India, and thereafter the company was kept alive only to receive payment of interest due on capital.

EAST INDIES. The name East Indies was formerly applied to the southeastern part of Asia, including Indo-China, India, and the Malay Archipelago. Today, however, the name is applied only to the Malay Archipelago and includes Sumatra, Java, Borneo, New Guinea, and hundreds of smaller islands. It was the East Indies that Columbus was seeking when he discovered America.

EAST RIVER. A narrow strait in New York City, the East River separates the boroughs of Manhattan and Brooklyn. It varies in width from one-half to three and one-half miles and is fifteen miles long, connecting Long Island Sound and New York Bay. The East River is crossed by

THE LONG ARM OF BRITAIN REACHES INDIA

The beginning of England's influence in India was the founding of the East India Company. In 1599, Sir John Mildenhall negotiated a trade agreement with Akbar, Mogul of India.

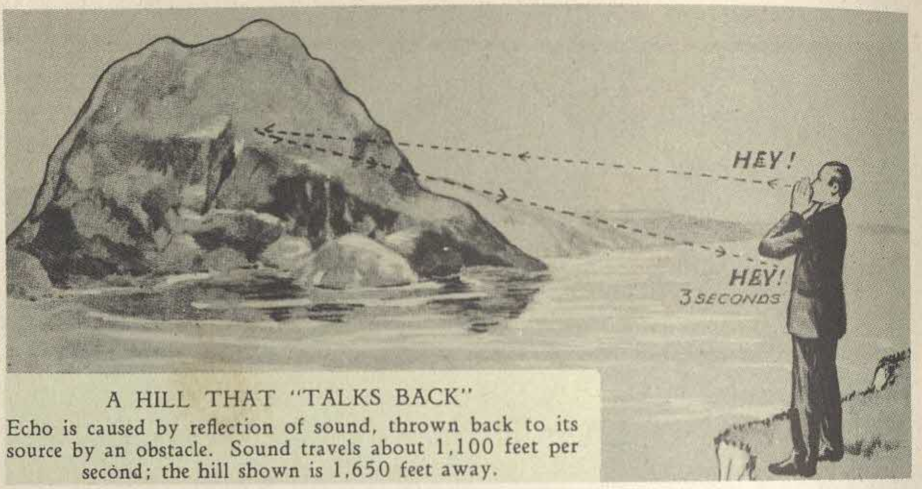
great suspension bridges: Brooklyn, Williamsburg, Manhattan, Queensboro, Hell Gate, and Triborough. The lower river is one of the busiest sections of New York Harbor (see NEW YORK CITY).

EB'ONY. So dark that "black as ebony" has become a common expression, ebony is a tropical wood of great value. The ebony of commerce is the black heartwood of certain trees. Some ebony comes from trees belonging to the family to which the locusts and peas belong, and some from members of another family.

Ebony wood is not only black, but it is very heavy and hard. It takes a beautiful polish and is used in inlaid works. It is also made into small boxes, knife handles, wooden ornaments, and the like. Some kinds of ebony are not uniformly black, but are streaked. These are not ordinarily preferred.

The trees producing ebony are often two feet or more in diameter. They are found growing in tropical regions, different sections of the tropics being favored for different types of ebony. India, Madagascar, Brazil, Egypt, and the Mediterranean region are the principal centers where ebony is grown.

ECCENTRIC, *ek sen'trik.* If a pin is put through a paper disc somewhere between its center and its edge, the disc will


HEY!
HEY!
3 SECONDS

A HILL THAT "TALKS BACK"
Echo is caused by reflection of sound, thrown back to its source by an obstacle. Sound travels about 1,100 feet per second; the hill shown is 1,650 feet away.

seem to rise and fall when it is spun around. This is the principle of the eccentric, a piece of mechanism which serves as a crank. An eccentric usually consists of a disc attached to a rod which slides around the inside of a larger circular bearing attached to a shaft. The eccentric gives the shaft not only an up-and-down motion but a forward-and-back motion as well. Eccentrics are generally used to open and close valves on steam engines.

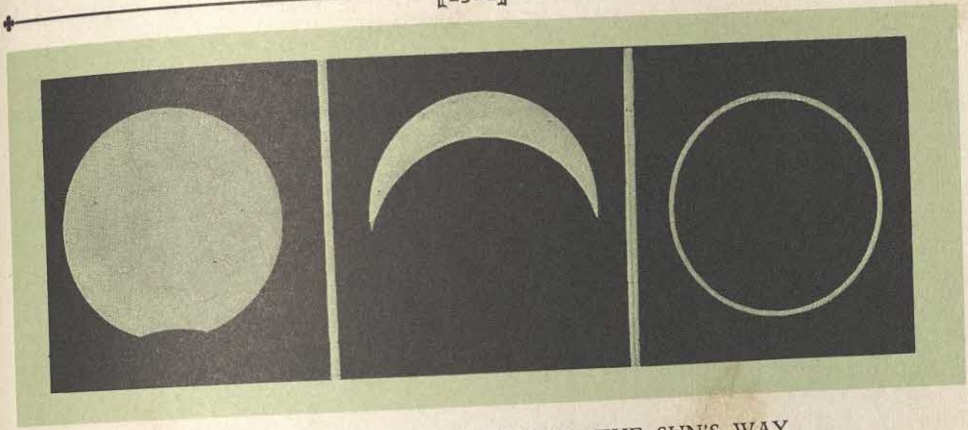
ECCLESIASTES, *ek kle ze as' teez.* Chiefly a poetical composition, *Ecclesiastes* is a book of the Old Testament, whose author is unknown. At one time it was thought to have been written by Solomon. However, its style and language and also its thought are now believed to belong to a much later period. The title of the book was interpreted to be the Hebrew name *Koheleth,* which means *preacher.* The book deals with the blessings of God, human virtue, justice, and immortality.

ECHIDNA, *e kid'nah,* **or SPINY ANT'-EATER.** Much like a large hedgehog in appearance, with long spines and a long, slender muzzle, the echidna is an egg-laying mammal found in Australia and New Guinea. Its diet consists of ants and other insects which it catches with its long sticky tongue that flashes with lightning speed through a small opening at the end of its muzzle. It catches its food at night and sleeps during the day. Each short, strong leg has five toes armed with sharp claws for burrowing in the ground. The echidna and its close relative the duckbill have some of the characteristics that mark mammals, birds, and reptiles.

ECHINODERMS, *e ki'no durmz.* The members of this great division of the animal kingdom are marine animals. They are called echinoderms because of their spiny skins and long, needle-like projections, for the term means *spiny-skinned.* Starfishes, brittle stars, sea urchins, sea lilies, and sea cucumbers are among the 4,800 species.

The typical echinoderm has a disc-shaped body with arms that radiate like the spokes of a wheel from a center. On the underside is an opening through which the animal feeds on seaweed, clams, oysters, and the like. It has a well-organized nervous system, and biologists rank it between an insect and a vertebrate.

ECHO, *ek'o.* Words spoken in front of forests, large buildings, or cliffs are sometimes repeated as if they had been uttered by another person. This phenomenon of repetition is called echo. It is due to the reflection of the sound wave when it strikes an obstruction, and is similar to the reflection of light by a mirror. A loud sound



SOMETIMES THE MOON GETS IN THE SUN'S WAY

But it doesn't always cover the sun completely. Here are two *partial* eclipses; one *annular*.

produced between two high walls may sometimes be reflected back and forth many times, so that several echoes are produced. The roll of the thunder is due to repeated reflections of the original sound wave from layers of air of different density; a number of echoes are produced, and they follow one another so closely that they give the effect of a single continuous sound.

By listening for the echoes of their shrill "singing," too high-pitched to be heard by human ears, bats are able to avoid obstacles as they flit about in the dark.

Sonar and related devices, which send sound waves downward through water and time their echoes, are used to measure the depth of the sea, to locate schools of fish, and to find objects which have been lost underwater.

Seamen can determine the direction and distance of cliffs in foggy weather by sounding the ship's horn or siren and noting where the echo comes from and how long it takes to reach them.

Special effort is made to prevent the formation of troublesome echoes in designing churches, concert halls, theaters, and other places where the clear transmission of sound is essential. In these places, and particularly where radio and television broadcasts and phonograph records are made, elaborate measures are taken to trap and absorb sounds so as to prevent echoes. A certain amount of echoing is necessary to make vocal and instrumental music "sound right." See ACOUSTICS.

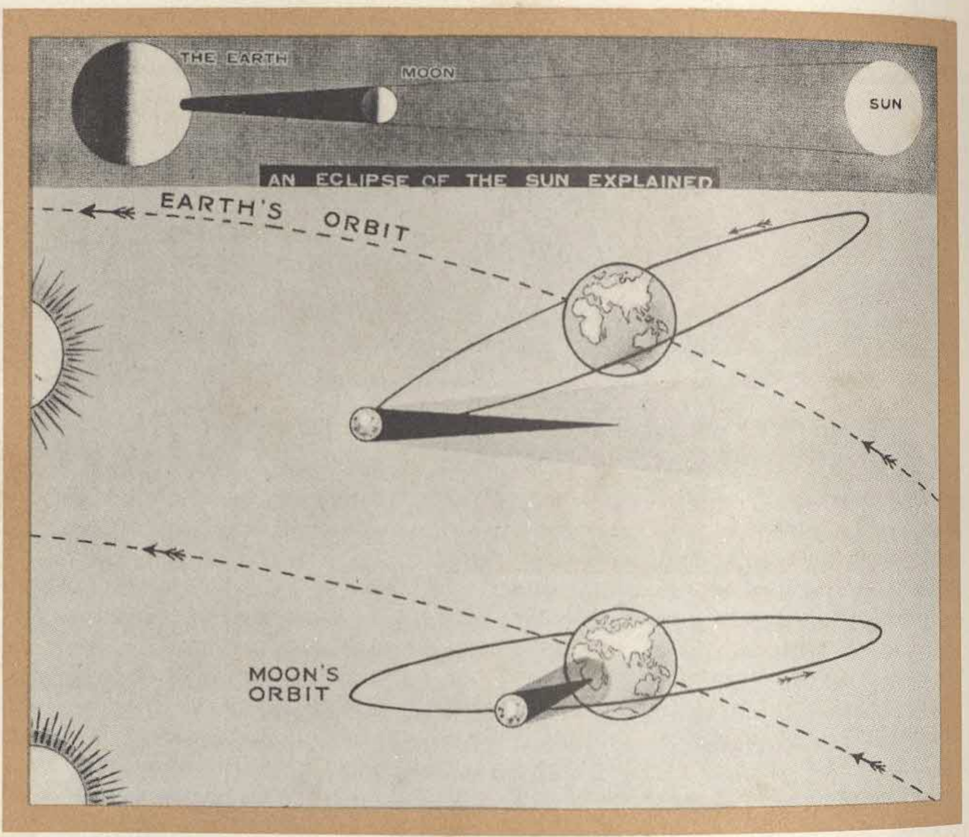
ECLIPSE, *e klips'*. Most of us have noticed the cloud shadows moving swiftly across the fields on a sunny day. Since the sun is the main source of our light, if something opaque like a cloud gets between it and the earth, a shadow is cast.

Occasionally the moon gets into such a position and, like the cloud, cuts off part or all of the sun from our view. This we call a *solar* eclipse. In most cases it is a partial eclipse and we may see it best through a piece of smoked glass, which prevents the bright light from the unhidden portion of the sun from blinding us.

The small size of the moon and great distance from the earth to sun make a total solar eclipse a rare occurrence in any particular place. It is visible only from a small area and never lasts more than eight minutes. The shadow makes a curved path never more than seventy miles wide and less than half the distance round the earth in length.

The moon shines by reflected light; hence, if the earth comes between the sun and moon, the latter receives no light from the sun; therefore it is temporarily dark and we call the occurrence a *lunar* eclipse. Total lunar eclipses may be visible for as much as two hours.

Eclipses of the moons, or satellites, of



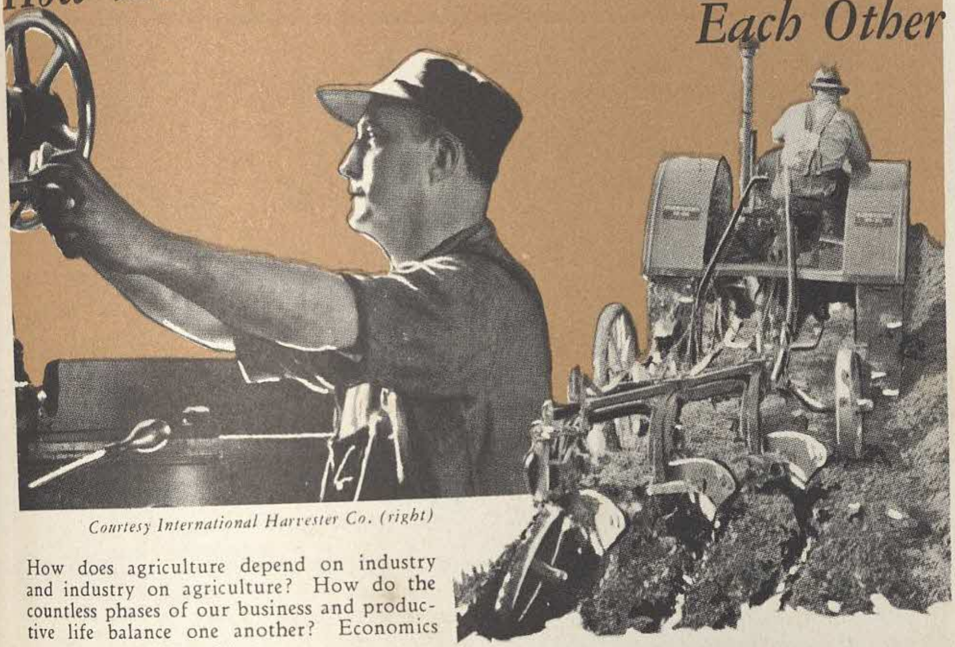
THE WORKING OF THE HEAVENS ON DISPLAY
An eclipse occurs when the moon passes directly between the earth and the sun (top). This combination is rare because the moon's orbit is not in the same plane as the earth's (below). In most cases, the shadow cast by the moon misses the earth entirely.

other planets may occur, also. Those of Jupiter are observed rather frequently. Thus, when Jupiter comes between one of his moons and the earth, our view of the satellite is cut off. Or if Jupiter imposes himself between one of his moons and the sun, the moon, being in a shadow, becomes invisible to people on earth. It is also usually true that if the satellite moves between Jupiter and us it is invisible. Lastly, when one of his moons passes between Jupiter and the sun, there will be a shadow thrown on Jupiter which can be seen crossing the surface.

ECLIPTIC, *e klip'tik.* In its revolution about the sun, the earth follows an oval path or *orbit.* Imagine a flat surface passing through that orbit and the centers of the sun and the earth; such a surface is called the *plane of the ecliptic.* If the plane were extended far enough it would seem to cut the dome of the sky. The ancients noticed that eclipses usually took place near where this plane cut the sky; hence, the name ecliptic. The belt lying eight degrees on each side is the zodiac.

ECOLOGY, *e kol'oje.* Corn will not grow in a bog; rice will not develop in a patch of sand. Every plant (and animal) thrives best under a particular set of suitable conditions. The relations of living organisms to their environment are the subject of the branch of biology called *ecology.* This science embraces not only the influence of environment upon plants, but the effect of plants on their environment.

How the World's Workers *Depend upon Each Other*



Courtesy International Harvester Co. (right)

How does agriculture depend on industry and industry on agriculture? How do the countless phases of our business and productive life balance one another? Economics answers.

The ecology of plants, which may be called *ecological botany,* is a valuable and practical science for the farmer. The other branches of botany are also helpful to him, for without knowledge of plant structure and plant evolution, botanists would not be able to build up a science of ecology. But ecology is more directly helpful. Theoretical botany, for instance, classifies plants according to their origin, and it is frequently helpful to know that spinach and pigweed are of the same family, and that the sweet potato is a morning-glory. But closely related plants often grow in far different environments, as do the cranberry and the huckleberry, and the farmer cares more about knowing which plants live in the water, which on the land, and, of the latter, which stand drought well, and which need moderate moisture.

When a farmer rotates his crops, or plants clover before potatoes, he is displaying a knowledge of ecology. For, among other things, this science treats of the effects of plants on the soil. If he has a wider knowledge of it, he will find many other ways to work his crops and soil in co-operation.

The study of animals in relation to their environment is known as *ecological zoölogy* (see ZOÖLOGY).

ECONOMICS, *ee ko nom'iks.* Sometimes called political economy, economics is the science which deals with such vital affairs as capital, labor, rent, wages, taxes, interest, tariffs—the fundamental aspects of all industry, finance, and commerce. It discusses the principles which govern the production, exchange, distribution, and consumption of everything upon which man places value, and it finds that these principles are grounded on natural laws.

It is impossible to study these principles without reaching a realization that all civilized peoples are to a great extent dependent upon one another, that they have immense interest in common. It was not always so; in the early days, when each family made its own clothing, provided its own shelter, raised all its foods, and lived in such isolation that extended communication was impossible, the theory of economics possessed no interest. It was only with the development of communication between neighbors, the opening up of avenues from them to distant sections, and the extension of such lines of communication over the country and beyond the seas, that man began to feel the need of things beyond his personal power to produce. Thus he began to build up systems of barter and exchange.

The development of the factory system, which gradually supplanted homemade production, gave rise to problems of price, cost, supply and demand. Economists recognize that wealth produced in a complex system, wherein people do not consume what they produce, is the result of combining the various factors of production, land, labor, capital, and business management. The science of economics establishes principles and laws which govern the distribution of wealth and income among the persons contributing these four factors.

In the process of dividing the dollars which the consumer pays for the goods and services he uses there are naturally many conflicting interests, and consequently friction will likely arise. The farmers, the manufacturers and the merchants will want to charge higher prices for what they have to sell, while everyone, including these same people, would like to pay less for what they buy in order to make their incomes go further. Moreover, working people want higher wages and salaries, capitalists want more interest for their money, land and building owners would like to raise rent, and the business managers try in every way to increase their profits; at the same time, each of these parties objects to the high charges of the other. It is the province of economics to study these various conflicting interests, and if possible to reconcile them so that the greatest permanent good will result to all.

In international relationships, barriers set up by rates of exchange, import quotas, tariffs, and the leveling of tariff laws by reciprocity are all within the province of economic discussion. In domestic commerce, the problems of money, coinage, bank credit, and other monetary problems are subject to economic principles.

Economics also deals with the problems of our government in raising money by taxes of various kinds for the support of schools, hospitals, recreation parks, and services such as police protection, the regulation of public utilities, the supression of monopoly, and conservation of natural resources. It should be understood, at least in an elementary way, by everyone who is interested in material progress, or who wants better to understand the world in which he lives and works.

Consult the following titles for additional information:

Boycotting
Capital
Child Labor
Communism
Conservation
Consumption
Co-operation
Corporation
Credit
Customs Duties
Debt
Distribution
Embargo
Exchange
Factory and Factory Legislation
Foreign Trade
Free Trade
Gresham's Law
Income Tax
Inheritance Tax
Insurance
Interest
Labor, Division of
Labor Legislation
Labor Organizations
Laissez Faire
Lockout
Money
Mothers' Pensions
National Debt
Old Age Pensions
Open Shop
Pension
Peonage
Population
Production
Profit
Profit Sharing
Protection
Real Estate
Reciprocity
Rent
Smith, Adam
Socialism
Society
Strike
Supply and Demand
Sweatshop System
Tariff
Tax
Tenement
Trusts
Usury
Wages
Wealth

ECUADOR, *ek'wah dawr*. Like a wedge driven into the side of South America lies the republic of Ecuador, land of many climes and products. Located in the northwestern part of the continent, it is bounded on the north by Colombia, on the south by Peru, and on the west by the Pacific Ocean. Its eastern boundary is indefinite.

Ewing Galloway

Wm. Lavarre, from Gendreau

ECUADOR'S INDUSTRY IS POWERED BY HAND

With a flashing wrist, the Colorado Indian, above left, gashes a rubber tree. The nimble fingers of the smiling girl, above right, make quick work of a finely woven panama hat. Below, workers screen dried cinchona bark, used for quinine, and pack bags for shipment.

C.I.A.A.

having been for years a bone of contention between Peru and Ecuador. The population approaches 4,000,000. Despite the settlement of the boundary dispute in 1942, estimates of Ecuador's area range from 105,000 to 276,000 square miles.

A Land of Unlimited Variety. Few countries equal Ecuador in variety of landscape, climate, or products. Ecuador is divided into three distinct regions, each of which has a different climate. Stretching inward from the coast is a great area of plains reaching to the foothills of the Andes. Here in a hot, moist, unhealthful area is the center of the agricultural production.

As one approaches the Andes to the east, the climate grows noticeably cooler, and on the summits of this equatorial mountain system genuine winter, with snow and ice, prevails. Most famous of these peaks are Chimborazo and Cotopaxi, each about 20,000 feet in height. Cotopaxi is of special interest, for it is the highest active volcano in the world.

On the eastern side of the mountains more great plains slope away into Brazil. The climate there is hot, the rainfall is heavy, and little development is to be seen. Here dwell primitive tribes, savage and pagan. Much of the area remains unexplored.

The rivers of Ecuador are only partly navigable because of their swiftness, though they are of some importance in the country's transportation system.

The republic is rich in minerals; great veins of gold and silver ore, as well as copper, iron, and mercury, are present. These are being developed by foreign capital. Emeralds and other gems are to be found in Ecuador, too, although little effort has been made to develop them. Much petroleum is produced here, chiefly by British companies.

Much of Ecuador is heavily forested, and forest products include cinchona bark, dyewoods, balsa, and rubber. Timber itself, because of poor transportation, has not become a leading product.

Ecuador's Industrial Life. The chief industry, as might be expected, is agriculture. Of importance are coffee, cacao, sugar cane, cotton, tobacco, and tropical fruits such as bananas, oranges, and pineapples. Grazing, too is important, hides being one of the chief exports.

Manufactured products include cotton and woolen textiles, shoes, leather, Panama hats, liquor, and mosaics.

The chief exports of the country are cacao, petroleum, gold, coffee, rice, fruits, rubber, and straw hats.

Transportation. Guayaquil, on the Guayas River near the coast, is the chief port. Good transportation throughout the country is lacking. Most of the waterways are navigable for only about sixty miles inland, and railways have a total length of only about 700 miles. There are about 1,500 miles of good highways, most usable during the dry season. Much is yet to be done in building highways, however, although the interior of the country gradually is being made accessible through the construction of new roads. Airlines connect Ecuador with other points along the Pacific coast.

People, Government, and Education. The people of Ecuador are chiefly descendants of the Incas; about 54 per cent are of mixed blood, 27 per cent are Indian, and less than 10 per cent are white. In Ecuador Spanish is the official language, and Catholicism is the chief religion.

Ecuador has a republican form of government. The chief executive (President) is elected directly by the people for a term of four years. The Congress consists of a Senate and a Chamber of Deputies, whose members also are chosen by direct election. The provinces, however, are administered by governors appointed by the central government. The women of Ecuador voted for the first time in 1939.

Education, although somewhat backward, is gradually making progress. There are about 275,000 children attending schools. Universities are located at Quito (the capital), Guayaquil, and Cuenca.

There are also four teachers' training colleges.

History. Previous to the conquest of Ecuador by the Spaniards in 1532, the country had been a part of the empire of the Incas. Joining with other colonies, Ecuador threw off the Spanish yoke in 1822 but remained a part of what is now Colombia. In 1830 it gained its undisputed freedom. The government, like that of other South American countries, has been unsettled, and the Constitution has been rewritten a number of times. Presidents of Ecuador have had much trouble in maintaining order, although no serious outbreaks have occurred. Next to the smallest country in South America, Ecuador had a long dispute with Peru over territories and boundaries. The settlement by arbitration in 1942 granted Peru a large area Ecuador had claimed. See ANDES; GALAPAGOS; INCA.

EDDY, MARY BAKER (1821-1910). Known as the Discoverer and Founder of Christian Science, Mary Baker Eddy was born near Concord, N. H. in 1821. She was educated in common schools and academies and by tutors. She first became known in New England as a contributor of articles and poems to newspapers and magazines.

Christian Science is a religion which Mrs. Eddy began to teach and practice at Lynn, Mass., in 1867. In 1866 she recovered in a wonderful way from a severe injury when she read an account of Christian healing in *The Gospel According to Saint Matthew* (chapter 9, verses 2-8). She connected this experience with the healings and the promises of healing recorded in the New Testament. From that time she devoted herself to learning, practicing, and spreading the religion which she named Christian Science.

Mrs. Eddy put the gist of her teachings into a book called *Science and Health with Key to the Scriptures,* which can be found in most public libraries. There are Christian Scientists and Christian Science churches in all of the United States and in many other countries, and Christian Science writings have been translated into nearly all languages. Mrs. Eddy's account of herself, a book called *Retrospection and Introspection,* is published in English, Danish, Dutch, French, German, Norwegian, and Swedish. *A Child's Life of Mary Baker Eddy,* by Ella M. Hay, is a biography of Mrs. Eddy written especially for children.

In 1932, when the National Council of Women invited American women to name the twelve greatest women leaders in the United States during the past one hundred years, the balloting gave first place to Mrs. Eddy. In 1933 a group of distinguished authors listed *Science and Health with Key to the Scriptures* among the one hundred outstanding books written by American women during the past one hundred years. This list was made for the International Congress of the National Council of Women, and the books were judged by literary standards and by their influence in molding public thought. See CHRISTIAN SCIENCE.

E'DEN. According to the Bible, (*Genesis II, III*), the first home of man was in the Garden of Eden. There Adam and Eve lived in happiness until they were driven out by God because of disobedience. The location of the Garden is thought by some Bible students to have been in the valley of the Euphrates River.

EDENTATA, *e den ta'tah.* Among the lowest of the mammals are the Edentata, a group of clumsy, awkward animals. The name means *toothless,* although not all Edentata are entirely toothless. Some of them, the pangolins and anteaters, have no teeth at all; others, such as the armadillo, sloth, and aardvark, have teeth only in the back of the jaws. For this reason, they cannot kill game and must live on insects and decayed animal matter.

Edentata have small, undeveloped brains. They move about on short, clumsy legs. As protection against their enemies, they have heavy coats of coarse hair and, in some cases, scales or horny plates. A few of the Edentata are found in Southern Asia and Africa, but most of them live in South and Central America. The nine-banded armadillo occurs in Texas.

Consult the following titles for additional information:

Aardvark
Anteater
Armadillo
Sloth

EDICT OF NANTES. See Nantes, Edict of.

EDINBURGH, *ed'in bur o,* Scotland. Just a few miles inland from the famous Firth of Forth, on the eastern coast of Scotland, lies the capital city of Edinburgh, rich in history and famed the world over as a great educational center. Built on three elevations, Edinburgh is surrounded by craggy hills on all sides except the north, where a gradual slope descends to the sea. Here it was that Mary, famous Queen of Scots, and John Knox, leader of the Reformation, carried on their violent controversy. The city, too, was the home of many famous literary figures, such as Scott, Stevenson, Burns, Carlyle, and De Quincey.

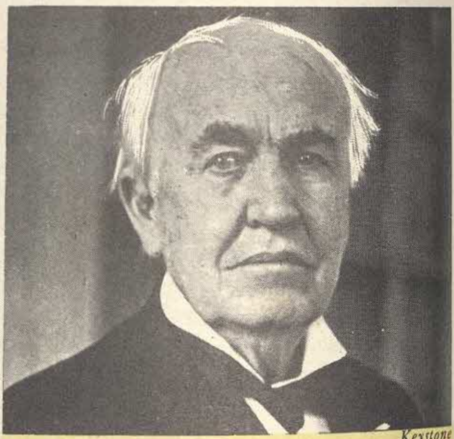
The city is divided into an Old Town and a New Town by Princes Street, one of the world's most beautiful promenades. Among the interesting buildings are the Castle and Saint Margaret's Chapel; Holyrood Palace, dating back to the reign of James V in 1528, and once occupied by Mary, Queen of Scots; the ancient Parliament House, now used by the supreme courts; the Bank of Scotland, and a number of beautiful churches, the most famous of which are Saint Giles', Gothic in style, and Tron Church. Of interest, too, is the great monument dedicated to Sir Walter Scott. Quaint old family houses of the Scottish nobility lend romantic charm to the city.

The University of Edinburgh, the Advocates' Library, with 250,000 books and 2,000 manuscripts, the Andrew Carnegie Library, the National Gallery of Scotland, and the Museum of Science and Art are among the educational and cultural institutions of Edinburgh.

The city is modern in every respect, with streetcars and gas, electric, and water systems equal to any in the world. Model tenements and public markets add to the cleanliness of the city.

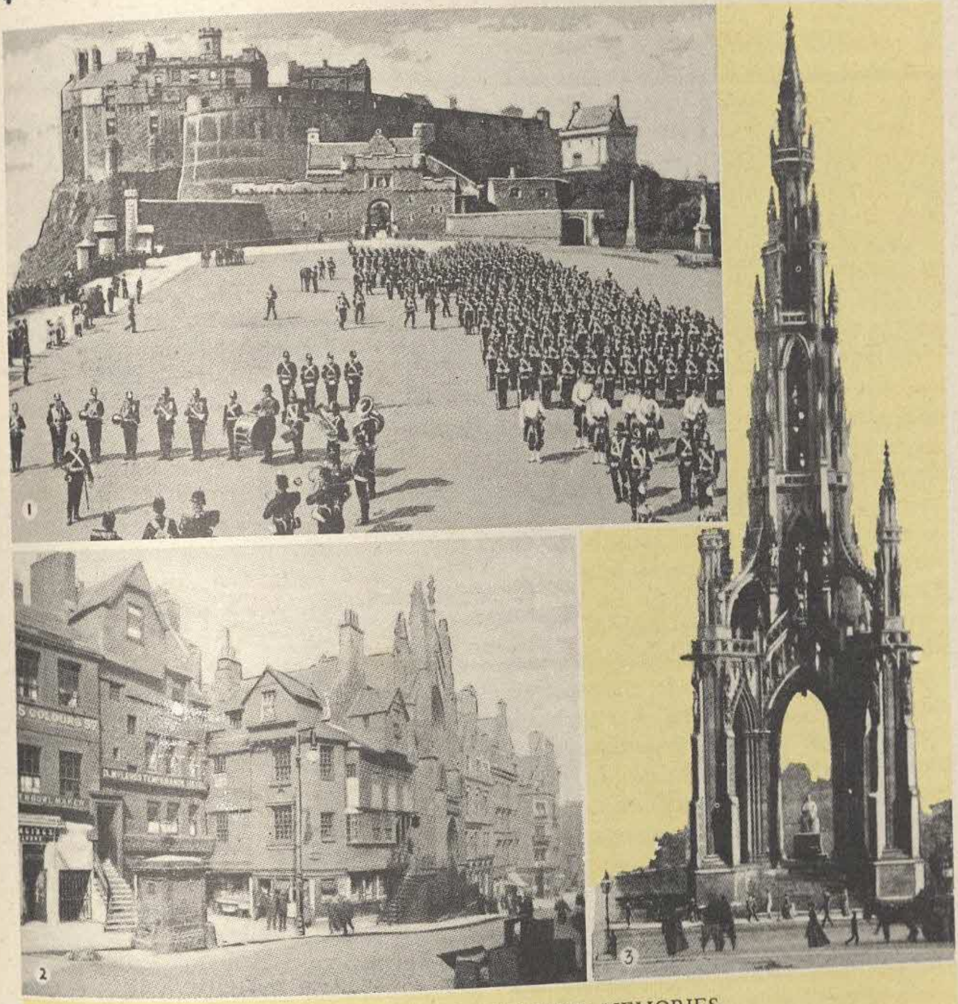
Among the industries worthy of mention are brewing, printing, and publishing. Leith, on the coast, serves as the city's port.

Edinburgh supposedly derived its name from Eadwinesburgh, after Edwin, a powerful Northumbrian king. It became a royal burgh in the time of Robert Bruce, yet was not recognized as Scotland's capital until the fifteenth century, under the Stuart kings. The population of the city is about 471,000.


Keystone

THE WIZARD OF MENLO PARK
Thomas A. Edison, who gave the world light.

EDISON, Thomas Alva (1847-1931). No inventer of modern times was more universally known and honored than Thomas Edison. As a result of his experiments he was granted over 1,200 patents. His name will be forever associated with the commercial development of the telegraph, telephone, electric light, storage battery, phonograph, dictating machine, moving and talking pictures, and other appliances which have added so much to human comfort and happiness. Upon these inventions some of the foremost industries in the United States are based. While he did not make many great scientific discoveries, he developed new and practical uses for scientific principles others had established.



SCOTLAND'S CITY OF RICH MEMORIES

Every weathered brick and stone clinging to Edinburgh's rocky hills seems to bear a wealth of tradition. (1) Forbidding Edinburgh Castle and the Scottish Guards. (2) The house of John Knox. (3) Sir Walter Scott's monument, with spire towering more than 200 feet.

"Everything comes to him who hustles while he waits." This was the motto which spurred on to such great achievement the man who said that "genius is two per cent inspiration and ninety-eight per cent perspiration." He believed in hard work and sticking to a thing until it was done. He went without regular sleep for days at a time, and for years established a working record of twenty hours a day. Instead of regarding deafness as a handicap, he looked upon it as an aid in avoiding distractions from his work.

Edison was born at Milan, Ohio. When he was seven years old, his family moved to Port Huron, Mich., where he attended public school. While a newsboy on the Grand Trunk Railway, he gave every spare moment to reading and experimenting with printing presses and mechanical and electrical apparatus. In a baggage car of the train he edited and printed the *Grand Trunk Herald*. He also fitted up a small laboratory; but his career there ended abruptly because of a fire resulting from his chemical experiments.

A grateful station master, whose child young Edison had saved from being crushed by an approaching train, taught him telegraphy. He became a successful operator; but because he was always looking and working for ingenious ways to improve himself, he could not hold a job long. While working as a "tramp operator" he invented useful appliances which soon became commercially profitable.

In Boston his stock-quotation printing device and other appliances used in brokers' offices were sold for $40,000. This enabled him to equip a laboratory at Newark, N. J., where he worked unhindered upon his ideas for more important inventions. Later he established larger laboratories at Menlo Park, N. J., and at Orange, N. J., where he made his home.

Greatest among his telegraphic inventions is the instrument by means of which several messages may be sent in opposite directions at the same time over the same wire. When Alexander Graham Bell patented the telephone in 1876, it had no transmitter. Without Edison's carbon transmitter the rapid development of this instrument would not have been possible.

Inspiration for the incandescent light came when Edison saw an arc light at a circus. Then began a series of experiments costing many thousands of dollars and much research before he succeeded in perfecting an electric device in which a loop of carbonized thread burned brightly and steadily in a vacuum for forty hours. The first commercially practical incandescent electric lamp was brought out in 1879. Fifty years later, all the world paid homage to its inventor in a "Golden Jubilee of the Electric Light."

Foremost among Edison's later inventions are the nickel-iron storage cell, the disc phonograph with a diamond-point reproducer, and the kinetoscope, a machine for projecting motion pictures.

In addition to these achievements, he was interested in the manufacture of portland cement and the magnetic treatment of iron ore. During World War I he designed and directed the operation of several large chemical plants. He was president of the Naval Consulting Board and invented numerous war devices. From his bed during his last illness, he conducted experiments with American plants from which he hoped to produce rubber.

Fortune and honor were his, but always his greatest satisfaction came from the joy of achieving his aim, often after years of apparently fruitless effort.

ED′MONTON, ALTA. Lying about 100 miles southeast of the geographical center of Alberta, Edmonton, its capital, is one of the most important grain centers in the world. Indeed, only one Canadian prairie city, Winnipeg, Manitoba, exceeds it in size. The city has staged a sensational growth; its population increased from 2,626 in 1901 to over 100,000 today.

Leading the many industries of the city are meat packing and the handling of wheat. Foundry work, sawmilling, brickmaking, flour milling, and a number of lesser industries also aid in keeping Edmonton's people employed.

The city lies in the center of an agricultural region and not far from a great timber belt. Near by there are over thirty coal mines. Natural gas is also present; and there are rich petroleum deposits. Closely linking Alberta with the rest of the Canadian provinces are two transcontinental railroads, the Canadian Pacific and the Canadian National; short lines radiate in every direction from the city.

The University of Alberta, Alberta College, a normal school, and a Catholic seminary provide the city with excellent educational advantages. Over forty churches are to be found there. The government, university, and banking buildings are among the finest in the city.

Starting as a mere trading post in the wilderness in 1795, Edmonton was later made an outpost of the Hudson's Bay Company. In 1905 it became the capital of the province of Alberta.

PRELUDE *to* Good Living

EDUCATION. In its broadest sense, education means any experience that develops the powers of man, but we have come to associate the term with what is learned in school, or *formal* education. It is difficult to overestimate the value of education. It is especially important under a democratic form of government, in which all classes of people take part. Despotism has maintained itself longest in countries where standards of education have been low.

Mankind has been concerned with education for a long, long time. As early as the seventh century B.C., elementary schools were found in Athens. Greek training laid special emphasis upon the proper development of the body and training in the fine arts. Plato's summary of the educational process was "gymnastic for the body, music for the soul." By the fifth century B.C., the intellectual aspect of education began to be emphasized. Rhetoric and oratory were the main subjects taught. Plato's *Republic* is the first scientific treatment of education. Roman education dwelt on the practical affairs of life, such as economics, military science, law, and politics.

The rise of Christianity and its spread through Western Europe gave a religious tone to education in the Middle Ages. The universities and monasteries were centers of learning. With the Renaissance there developed a broader view of education, and in the seventeenth and eighteenth centuries, the foundation of modern teaching was laid. John Amos Comenius (1592-1670), a Moravian clergyman, published the first illustrated textbook, *The World in Pictures*. In England, John Locke (1632-1704) emphasized the importance of physical and moral development, and in 1693 wrote a forward-looking book entitled *Thoughts Concerning Education.*

The outstanding educator in the eighteenth century was Jean Jacques Rousseau (1712-1778), a Frenchman. His theory of permitting children to develop through natural self-expression was set forth in *Émile*, one of the world's greatest books on child training. The nineteenth century saw great progress in education. To Johann

SCHOOLS OF OLD

Word of mouth was the original method of education. A wise man simply told the youths all he knew, then "examined" them with questions. Some of the greatest thinkers were these "tutors" of old; among them Socrates, who taught Alcibiades (above) and others. Left, Saint Thomas Aquinas teaching at the school of Albertus Magnus (thirteenth century).

Pestalozzi (1746-1827), a native of Switzerland, is due the credit for having made psychology a major factor in education. Friedrich Froebel (1782-1852), a German, won immortal fame as founder of the kindergarten. In England, Herbert Spencer (1820-1903) emphasized the social aspects of education. He held that the individual should be trained to take his place in the world; this conception has persisted to this day.

Trends in American Education. The first schools in America owed their origin to the religious zeal of early colonists. Gradually, as the middle of the eighteenth century was reached, three widely different concepts of educational practice became established in America. The first of these is the theory of a state-sponsored and state-supported public-school system. The second concept is the parochial, which is illustrated in the schools of Roman Catholics, German Lutherans, or Quakers. The third idea—held chiefly by the Church of England—is that public education is a charity, limited to the children of the poor; the children of well-to-do parents are to attend religious and other private schools. These three conflicting theories of education have all influenced American educational practice, but the first principle finally prevailed sufficiently to shape the national system of education in the United States.

In the early days of the nation, compulsory education was far from being generally adopted. The struggle for free schools in the United States has been long and at times bitter. One of the outstanding leaders of public education was Horace Mann (1796-1859) of Massachusetts. Henry Barnard (1811-1900) of Connecticut, the first United States Commissioner of Education, was another influential educator. Gradually, one state after another passed compulsory school-attendance laws, until now every state in the Union compels children, usually those from six to sixteen years of age, to attend school a given number of days each year.

Not only has there been a change in the length of school term and number of pupils attending school, but there has been a change in the kind of instruction offered in the public schools. Before the middle of the nineteenth century, the course of study was decidedly limited. Much was made in the elementary schools of the "three R's," reading, writing, and arithmetic. These core subjects, together with geography and history, for years constituted the major part of the elementary curriculum. A broadening of the curriculum has been an outstanding feature of more recent years.

The American high school, as an institution, has practically developed since 1850. The early high schools and academies of New England were intended only for the "more promising lads," but today they are open to all. The curriculum of the high school has been primarily concerned with preparing young people for college. Hence, the so-called academic course has predominated, and still does predominate, in a great many high schools. Other high schools, however, have placed increasing emphasis on vocational courses designed to prepare pupils for various occupations. Commercial courses and courses in trades and industries, both in day schools and in night schools, have been introduced in many cities. Today, in most high schools, students may choose between courses preparing them for vocations and courses preparing them for advanced education.

EXPLORING THE UNKNOWN

A world of tiny beings opens before the eyes of these young students as they examine plants and animals under the microscope.

Brooklyn Children's Museum

TRADITION-FILLED HALLS OF LEARNING

Phillips Exeter Academy (left) prepares boys to enter Harvard (right), and so follows a rigid classical curriculum, carefully stressing Harvard's academic atmosphere.

The broadening of the high-school curriculum is but one of the trends in modern American education; there has also been a revision of methods of instruction. Another tendency has been the reorganization of secondary education to provide for the junior high school. Still another has been the inclusion of the kindergarten in the public-school system.

Higher institutions, even more than the early secondary schools of America, were limited to the educational aristocracy of the country. The old Latin grammar schools were organized as preparatory schools for Harvard, Yale, and Princeton, and were intended for a select class. As the nation grew in wealth, more people, including the middle classes, began to attend institutions of higher learning. Thus, there came into being the American academy, which for a hundred years played an important part in the educational system. As elementary and high schools became established as publicly supported institutions, gradually the demand for publicly supported institutions of higher learning arose for rich and poor alike.

Normal schools, land-grant colleges, and state universities, as well as numerous denominational colleges, sprang up everywhere. State universities, now established in every state in the Union, offer a great variety of courses ranging from those purely academic in character to those intended for the most highly trained professions. Graduate courses, providing technical as well as professional training, have been added to standard four-year college and university courses.

One of the more widespread tendencies in higher education is the development of junior colleges, the purpose of which is to give the general courses often given in the first two years by standard colleges.

Most of the subjects taught in elementary and higher schools are treated in this work under their own titles. Other information may be found under such headings as the following:

Colleges and Universities
Congress of Mothers, National
Corporal Punishment
High School
Illiteracy
Kindergarten
Library
Montessori, Maria
Parents and Teachers, National Congress of
Rhodes Scholarships
Schools
Vocational Education

EDUCATION, OFFICE OF. Unlike national education offices of other countries, the United States Office of Education was set up in 1867 to serve only in an advisory capacity. True to the American tradition that education should not be nationally controlled, the office, which is now under the Federal Security Agency, is careful not to interfere with the state educational systems. Surveys and studies of the problems of education are carried on. The results are published in circulars and bulletins which may be obtained upon request. Among the divisions within the office are those on rural education, school administration, home education, and school hygiene.

Commissioner of Education. Henry Barnard was the first head of the Office of Education. The Commissioner of Education, as he is called officially, is appointed by the President with the consent of the Senate, and must present a yearly report to Congress. The general purpose of his office is the improvement of education throughout the country. The information gathered is distributed in an effort to decrease illiteracy and improve the organization and management of public schools. Besides the yearly report to Congress, the Commissioner publishes a report every two years, embodying his suggestions and containing information on schools in various countries.

EDUCATION ASSOCIATION, NATIONAL. Formed in 1857 by a group of teachers for the purpose of advancing and unifying education in America, the National Education Association has today a membership of over 350,000. When first organized in Philadelphia, it lacked strength, but, starting in 1870, various divisions within the group were created to provide a better means for studying particular problems. Today it has twenty-nine different departments, ranging from the division of elementary classroom teachers to that of superintendents. Over all is a National Council.

Yearly meetings are held, at which talks are given and round-table discussions on various problems are conducted by noted educators. The proceedings of the meetings are published, as are the reports of the committees on special topics. The Association maintains its headquarters in Washington, D. C.

EDWARD, called THE CONFESSOR (about 1004-1066). Next to the last of the Saxon kings of England, Edward the Confessor is remembered in history as a saintly and religious man. Succeeding his half-brother, Hardicanute the Dane, he held the throne from 1042 until his death. It is said that one of the claims of William the Conqueror to the throne of England was a promise made by Edward. Edward was made a saint nearly a hundred years after his death.

EDWARD, THE BLACK PRINCE (1330-1376). During the Hundred Years' War, England's glorious victories over the French in the battles of Crécy (1346) and Poitiers (1355) were due largely to the bravery and generalship of Edward, the Black Prince. Eldest son of King Edward III, he ruled over Aquitaine as a result of the Peace of Bretigny and, in England, resisted his father's harsh laws. Although he was a brave and considerate warrior, history has been unable to forget the cruel and needless slaughter of 3,000 inhabitants of Limoges ordered by the Black Prince when he captured the city from the French in 1370.

EDWARD I (1239-1307). One of the greatest English monarchs to bear the name of Edward, Edward I succeeded his father,

A NEW PRINCE FOR WALES
King Edward I of England conquered the Welsh, and when a son was born to him, he gave him the title Prince of Wales, as heir to the throne.

Henry III, in 1272. Having put down several revolts in Wales before he ascended the throne, Edward annexed that country during his reign. He also sought to annex Scotland to England, but was resisted by Robert Bruce. It was during a campaign to subdue Scotland that Edward died.

The most significant development in Edward's reign was the growth of Parliament, which was given the power to levy taxes. Edward had profound influence on the laws of England, many of which are cornerstones of modern common law. His efforts to prevent the clergy from obtaining too much power over the people were successful, setting a precedent for future monarchs.

EDWARD II (1284-1327). Unlike his father, Edward I, this king of England was a weak and incompetent ruler. He came to the throne in 1307 and attempted to carry on the campaign to bring Scotland under English rule. In 1314, however, a decisive victory for the Scotch at Bannockburn, under Robert Bruce, checked him. Later, after a humiliating treaty, he was deposed as ruler by his wife and a group of nobles. He was murdered in 1327.

Edward, before he became king, was the first Prince of Wales, proclaimed "Wales' king" by his father to placate the defeated Welshmen.

EDWARD III (1312-1377). Even if England had not begun The Hundred Years' War under Edward III, the fifty-year reign of this monarch would be outstanding. For during his reign, English literature made great progress through the writings of Geoffrey Chaucer.

Edward became king in 1327, after the murder of his father, Edward II. His strong-willed mother, Isabella, who had plotted against his father, attempted to rule the country for her fifteen-year-old son, but he banished her shortly after his accession. Like the two Edwards before him, he attempted to conquer Scotland; but despite a victory at Halidon Hill in 1333, he was unsuccessful. Later, Edward decided to invade France to punish the French for aiding Scotland. Another reason for the invasion was that he considered he had a claim to the throne of that country. Thus began the Hundred Years' War, which impoverished England. When he returned from France after several campaigns, Edward quarreled constantly with Parliament and with his son, the Black Prince. See HUNDRED YEARS' WAR.

EDWARD IV (1442-1483). First of the three kings of the House of York, Edward IV came to the throne of England by force of arms in 1461. Henry VI of the House of Lancaster had been deposed; and Edward, a great-great-grandson of Edward III and

A BRITISH KING INVADES FRENCH TERRITORY

In the fourteenth century, King Edward III launched a war on France because he believed the French had aided the Scots against him. Though Edward III captured the French king, the campaign gained nothing but exhaustion for England.

ENGLAND GETS A BOY MONARCH
Edward VI rode into London as king at the age of ten. During his six-year reign the youthful monarch was dominated by courtiers and ministers, notably the Earl of Warwick.

leader of the Yorkists, marched into London. Proclaimed king, he immediately tried to make his throne secure but was forced to flee the country. He returned in 1471, defeated the Earl of Warwick (who led the Lancaster sympathizers), and reigned peacefully for the remainder of his life. See ROSES, WARS OF THE.

EDWARD V (1470-1483). Blood and murder have marched side by side with glory and grandeur in the history of the English throne. One of the blackest tragedies of all is the story of Edward V, who never had a chance to rule.

Only thirteen years old when his father, Edward IV, died, he came to the throne in 1483 under the protection of his uncle, the Duke of Gloucester. The duke claimed that Edward and his young brother were not the legal sons of Edward IV and imprisoned them in the Tower of London. There the two princes, innocent and helpless, were murdered. Their uncle seized the throne and ruled as Richard III.

EDWARD VI (1537-1553). Son of Henry VIII by his third wife, Edward VI ruled England only six years. He became king in 1547, when he was only ten years old, and the actual administration of the kingdom was in the hands of first his uncle,

THE REGAL PERSONAL SYMBOLS OF BRITAIN'S IMPERIAL STRENGTH AND UNITY

Rulers of England at the peak of world influence: Edward VII and his beautiful queen, Alexandra, as they looked in 1901.

Edward Seymour and then the Earl of Warwick. His death from illness when he was sixteen provoked considerable strife over the succession to the throne, resulting in several executions. Mark Twain's story, *The Prince and the Pauper,* was based on this young king.

EDWARD VII (1841-1910). Few persons expected Edward VII to show great wisdom and ability when he ascended the throne of England in 1901, following the death of his mother, Queen Victoria. But during the nine years of his reign, England's relations with foreign countries were marked by increased understanding and friendship, owing in large part to Edward's knowledge of world politics.

Eldest son of Prince Albert and the famed Queen Victoria, Albert Edward was born November 9, 1841. Following attendance at Edinburgh, Oxford, and Cambridge universities, he visited the United States and Canada as the Prince of Wales and, in 1862, made a tour of Africa and India. A year later he married Princess Alexandra of Denmark. His six children were Albert Victor, who died in 1892; George, who became George V; Louisa, Victoria, Maude, and Alexander John, who lived only one day.

Because Edward interested himself little in the politics of his country, it was thought that he would make a poor king. However, in his many travels he was given the opportunity of studying problems of government. As a result, he developed a keen insight into the affairs of England, and an understanding of international relations.

EDWARD VIII (1894-). The oldest son of George V was the only king in the history of the English monarchy who ever gave up his throne willingly. Ruling less than a year, Edward VIII was England's uncrowned king. Educated at Oxford, Edward served with the English forces in the World War. As Prince of Wales, he was the British Empire's "salesman" in his numerous travels throughout the world after the war. Upon the death of his father, George V, on January 20, 1936, he ascended the throne.

A few months later, he announced his intention of marrying Mrs. Wallis Warfield Simpson, an American-born divorcee; government opposition to the marriage led him to give up the throne. He abdicated on December 10, 1936, and in 1937 became Duke of Windsor. He acted as governor of the Bahama Islands from 1940 to 1945 and lived abroad thereafter.

EDWARDS, Jonathan (1703-1758). The author of one of the first outstanding books on philosophy in America, *Freedom of the Will,* Jonathan Edwards has had a deep influence on religious and moral thinking in the United States. Born at East Wind-

SLENDER AND GRACEFUL FOOD FISH

Eels are among the most remarkable of fish in both appearance and habits. They are caught and marketed as food fish in both North America and Europe.

Courtesy Armour and Co.

FEATHERED FOOD FACTORIES

Hungry people eat eggs by the million. Some eggs they don't eat hatch into chickens, which produce more eggs (above).

sor, Conn., he was graduated from Yale College when he was seventeen and in 1727 became a preacher at Northampton, Mass. A brilliant orator, he was dismissed from his post because he disagreed with authorities on many points of religion. He became a missionary to the Indians, and it was during this time that he wrote his famous book.

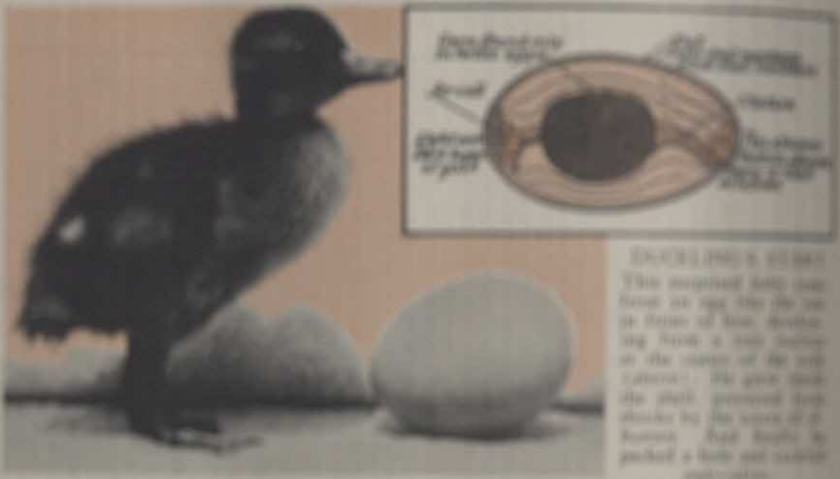
EEL. A long, slimy, snakelike, almost scaleless fish, the eel is found in fresh-water streams on both sides of the Atlantic Ocean. Eels frequent salt water only when they go to sea to lay and hatch their eggs. They are sluggish during the day but become active at night, often crawling great distances on land through damp grass. They are considered an excellent food fish, although many people are prejudiced against them because of their snakelike appearance.

EG'BERT. Considered the first ruler of England, Egbert united all the independent kingdoms under one head. Of royal blood, he became king of Wessex in 802 and had made all the other kingdoms dependent on him by 830.

EGG. Most people think of eggs only as a food. But important as they are as food, that is not their essential purpose. For not only birds, but worms, insects, mollusks, most fish, and some snakes hatch their young from eggs. In fact, all life, except that reproduced by cell division, originates in the egg.

Birds' eggs are surrounded by a hard shell composed almost wholly of carbonate of lime to protect the interior. Within the shell is a lining of thin, tough membrane. Inside this lining is the white, composed of albumen, by which the yolk is surrounded. The yolk is also enclosed in a thin membrane. This yolk, usually spherical, is composed of various substances and is yellowish in color. Within the yolk is a *germ spot,* from which the young bird is developed. In the large end of the egg is an air space, and it is this supply of air that the young bird breathes as it pecks its way through the shell at hatching time.

Bird eggs are hatched by heat from the mother bird's body as she sits on the nest. A temperature of about 104° is necessary, and the time required for hatching may



DUCKLING'S HOME
This surprised baby came from an egg like the one in front of him, developing from a tiny embryo at the center of the yolk (above). He grew inside the shell, protected from shocks by the white or albumen. Each [illegible] is packed a little [illegible] [illegible].

vary from seven days for eggs of the wren to a month for turkey eggs. Some wild birds lay but one egg a year, others as many as seven.

Each species of bird has a distinctively colored egg. Those of the robin are greenish blue, of the cuckoo a light green, of the bobolink a speckled brown, and so on. Birds building their nests in trees lay oval-shaped eggs. Those living in nests on the ground or in dangerous places, as on cliff shelves, lay eggs rounded at one end and sharply pointed at the other. This shape prevents their rolling away from the nest, for they can roll only in a circle.

The Eggs of Domestic Fowls. Ducks, geese, turkeys, guineas, and chickens lay eggs which are used as food. By far the most important are the eggs of chickens. They are rich in food value, especially protein and fat, and, if properly cooked, are one of the most satisfying of foods.

So important has the egg industry become that many farmers devote almost all their time to raising chickens for their eggs. Experience has shown that Leghorn, Barred Rock, and White Rock chickens are the best egg producers. On many chicken farms, special laying houses are built for the hens, electric lights are installed, special laying mash is fed, and the hens are kept in sanitary surroundings. All these factors are of the utmost importance in maintaining good egg production.

Eggs are usually sold to local dealers who *candle* them by shining a light through them to discover any that are defective. When the defective ones have been removed, the rest are carefully graded according to color, freshness, and size. Then the eggs are either sold locally or are packed for shipment to the large city markets. Careful packing, usually in specially designed cases or cartons, is very important, for eggs break easily. Those for home use are generally packed in cartons of a dozen eggs each; those for quantity users, in cases of thirty dozens each. If the eggs are to be sent a long distance, especially in warm weather, they are usually shipped in refrigerated trucks, though some still travel via refrigerated freight cars.

At the city market, the commission merchant may have the eggs candled, or graded, and repacked, but most such handling is now done in the country. In any case, he distributes the eggs to retail grocers for sale to the public, to restaurants, bakeries, candy or other food-producing factories, or to plants that freeze or dry eggs. Or he may place the eggs in cold storage where they will remain until there is an egg shortage, as often happens during the late summer and fall months. Many farmers also sell fertile eggs to hatcheries, which specialize in producing baby chicks for sale to poultry-raisers. Billions of eggs are marketed yearly. See POULTRY.

Delicacies. Various kinds of preserved eggs are considered delicacies in China and are also one of that country's chief exports. Plover eggs are highly prized by many people, as are the eggs of certain sea birds in Labrador and various other places. Fish eggs, or roe, also are relished by many. See CAVIAR; ROE.

EGGPLANT. Though first found in South America and considered a tropical plant, this vegetable is now grown in many parts of the United States. Belonging to the same family as the potato, it is a low, bushy plant with grayish-green, hairy leaves and egg-shaped fruit. The eggplant popular in America has a glossy purple skin and may be nearly as big as a football. It is usually steamed, baked, or french-fried.

EGLANTINE. In America, the eglantine is the sweetbrier rose. See ROSE.

EGRET, *e'gret.* Herons that bear long, delicate plumes on their backs during the

PROTECTED PLUMES

Egrets, [illegible] [illegible] [illegible], [illegible] [illegible] [illegible] for [illegible] [illegible]

breeding season are called egrets. The plumes, formerly in demand for the millinery trade, are known as aigrettes. A few decades ago egrets lived in great colonies in Florida, but the demand of fashion for the plumes led to the destruction of the birds by the hundreds of thousands until they became scarce. Fortunately, they are now protected by law and are slowly increasing in numbers.

Three species of egrets are found in North America: the American egret, pure white and [illegible] inches long; the snowy egret, smaller but most beautiful of all egrets; and the reddish egret, of which only some individuals are white. Egrets live and nest in colonies, laying two to five pale, dull bluish eggs in rude nests placed in bushes or tall trees, often over water. They nest as far north as North Carolina in the East and [illegible] in the West and occasionally wander to Southern Canada after the breeding season. See HERON.

…ce Canadian Pacific; By Duane Dickason, from Ewing Galloway, N.Y.

THE SPHINX AND HIS CHILDREN

Young Egyptians of today look to the future with new hope and determination.

EGYPT, *ē′ jipt,* home of one of the oldest civilizations known to man. In its 6,000 to 7,000 years of life, Egypt has contributed much to the world. From the Egyptians we learned how to irrigate the soil. Thousands of years ago, these people raised water from low to high places by means of weighted buckets, machines called *shadoofs.* The plow was an Egyptian invention; so was linen, one of the first cloths man ever used. The Egyptians devised the first system of telling time by means of a shadow clock. And they invented an amazingly accurate calendar with twelve months, each composed of thirty days.

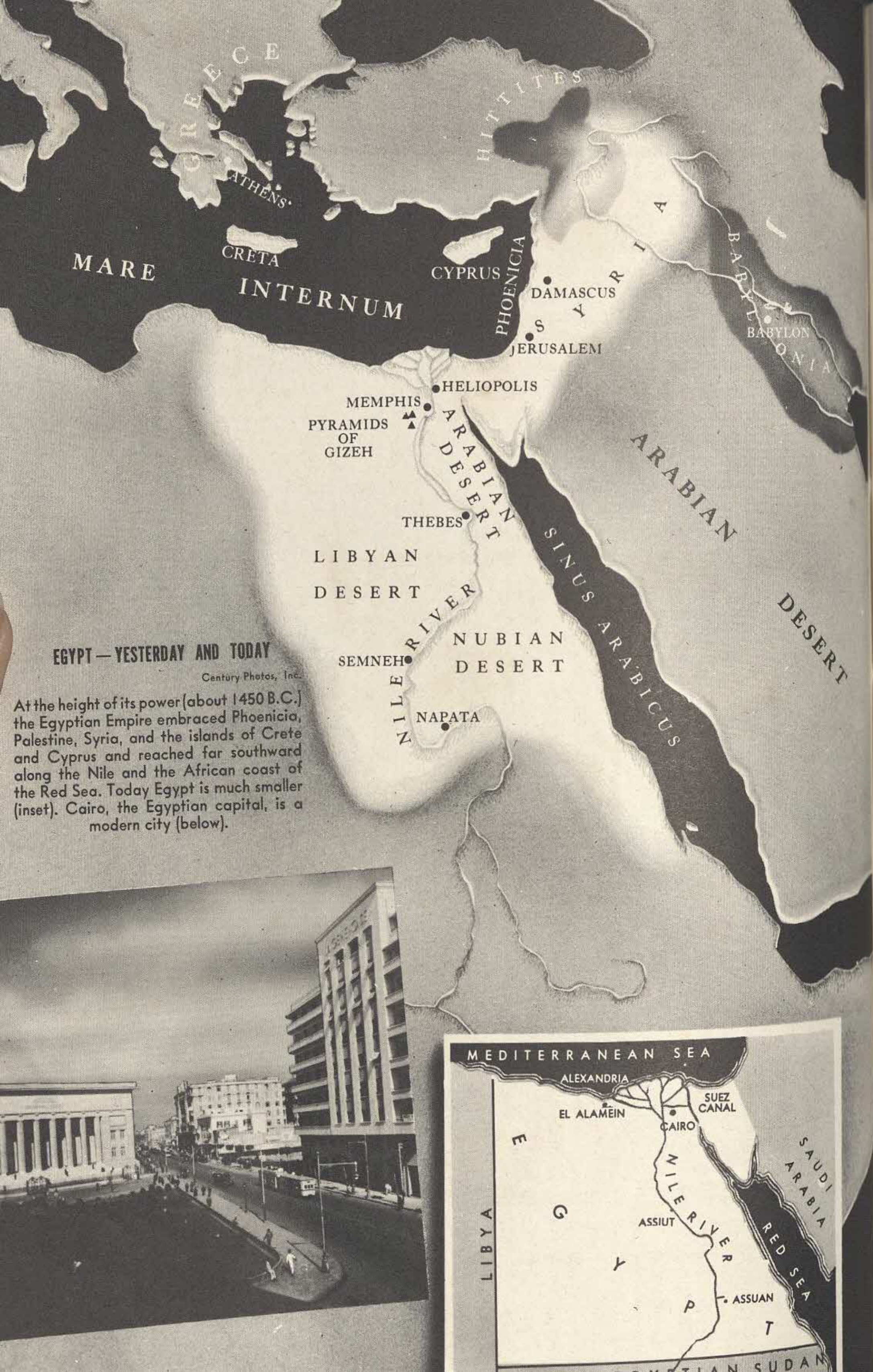
Papyrus, man's first paper, was another Egyptian contribution. The Egyptians took the inner layers of the papyrus plant, separated them into thin strips, arranged them side by side on a smooth surface, and placed others crosswise on top. After the fibers were soaked in water, they were placed under pressure and rubbed with ivory, shells, and smooth stones. After drying in the sun, the sheet was polished, forming a permanent writing material. See Paper; Papyrus.

In architecture the Egyptians devised the *clerestory* for windows in temples, and they were the first people to use the column in buildings. Their hieroglyphic alphabet

REGAL BEAUTY FROM EGYPT'S PAST

One of the world's greatest art treasures is this serene sculpture of Queen Nefertiti of Egypt (opposite page), who lived in the 1300's B.C. This bust, discovered in 1912, was buried in the mud and sand of the Nile for centuries. It was hidden in a salt mine during World War II, where American troops found it. Not until 1956 was it restored to its air-conditioned case in a Berlin museum.

Eliot Elisofon—LIFE MAGAZINE, copyright 1956 Time, Inc. With approval of the Staatliche Museen [illegible]



EGYPT — YESTERDAY AND TODAY

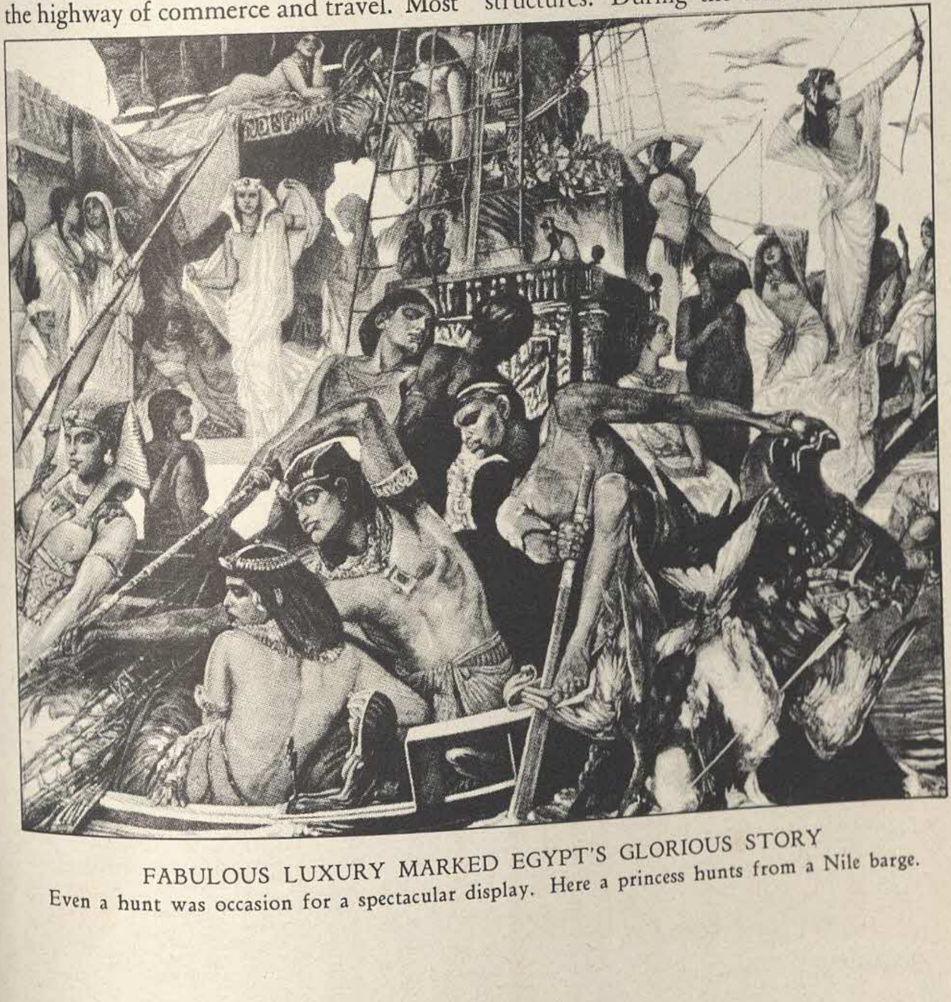
Century Photos, Inc.

At the height of its power (about 1450 B.C.) the Egyptian Empire embraced Phoenicia, Palestine, Syria, and the islands of Crete and Cyprus and reached far southward along the Nile and the African coast of the Red Sea. Today Egypt is much smaller (inset). Cairo, the Egyptian capital, is a modern city (below).

consisting of 600 syllable pictures, was the forerunner of the modern alphabet. At first used only for sacred purposes, hieroglyphics later included all forms of writing. Embalming was first practiced by the Egyptians, and the mummies found in the tombs today bear witness to the excellence of the methods. The Egyptians were the first people we know of who used ships extensively, employing both sails and oars. Ancient writings also indicate that the Egyptians were the first people to believe in one God; but this faith, which existed long before the Jews came into being, was superseded by the belief in many gods.

Where a River Means Life. The Nile River is the life stream of Egypt. It always was, and still is, the center of Egyptian life, the highway of commerce and travel. Most of the more than 24,000,000 Egyptians live, just as their ancestors, along the banks or the delta of the river, for the remainder of the country's 386,000 square miles is desert waste. Lower Egypt, the land of the delta, faces the Mediterranean Sea; bounded by Libya on the west and the Red Sea on the east, it is level and fertile. Upper Egypt, surrounding the southern portions of the Nile, is hilly and mountainous in the east, where the Arabian Desert defies habitation. West of the Nile in Upper Egypt is the Libyan Desert, a sandy and desolate region. To the south is the Sudan, formerly Anglo-Egyptian Sudan but now self-governing.

The dry, sunny climate of Egypt accounts for the preservation of the ancient structures. During the summer the delta



FABULOUS LUXURY MARKED EGYPT'S GLORIOUS STORY

Even a hunt was occasion for a spectacular display. Here a princess hunts from a Nile barge.

FROM A COLORFUL PAST TO A FASCINATING PRESENT

The lemonade vendor (right), dressed in garments of Oriental Egypt, plies a modern trade. But the historic past is never forgotten; left, the statues of Rameses II.

region is usually very hot, the temperature mounting to 100° or more. In the winter, however, the northern breezes of the Mediterranean provide a mild climate. Upper Egypt has a more constant temperature, which is usually high.

Egypt Today. Even though Egypt has been outstripped by younger nations which owe part of their civilization to this ancient land, it has a unique importance in the world. Connecting the Red Sea with the Mediterranean is the Suez Canal, the gateway of trade between Europe and the East. The British and the French controlled the Canal from 1875 until 1954, and closed it to enemy ships in World War I and II. After World War II, the Egyptians demanded ownership of the Canal and its zone. The British removed their troops from the zone in 1956. Premier Gamal Abdel Nasser of Egypt seized the canal and put it under Egyptian control.

Agriculture, the chief means of livelihood for the fellahs, or peasants of Egypt, is dependent entirely upon the Nile, since the little rainfall provides insufficient moisture. Formerly, the uncontrolled yearly overflow of the river deposited a layer of black silt over the bordering lands, leaving them fertile and moist enough to grow a single annual crop. The Assuan Dam of 1902 made it possible to irrigate much dry land, and to raise two or three crops a year. The tremendous High Assuan Dam was started in 1960 to irrigate a much greater area and provide huge amounts of electric power.

Despite some improvements in recent years, many of Egypt's farmers still use methods and tools as primitive as they were when the pharaohs held sway. Their chief crops include cotton, sugar cane, corn, barley, wheat, rice, vegetables, dates, and grapes. Livestock raising is carried on chiefly by the country's nomadic Bedouins in the eastern desert, where cattle, sheep,

Above, from one of a series of oil paintings, "A History of Pharmacy in Pictures," commissioned by and copyrighted by Parke, Davis & Co.; reproduced by special permission. George A. Bender, project engineer; Robert A. Thom, artist.

TEMPLES OF LEARNING AND WORSHIP IN EGYPT

The priests-pharmacists of ancient Egypt (above) learned and practiced their arts in temples like the Temple of Hathor (below), whose weathered figures still guard the entrance.

UNESCO-Laurenza

goats, horses, donkeys, camels, and water buffaloes for turning irrigation water wheels are grazed.

Although industrialization has begun, Egypt still has few factories. Its chief industries include sugar refining, cotton ginning, grain milling, and the manufacture of cement, pottery, soap, perfume, and cigarettes. Fishing is of some importance, as is mining, the chief minerals produced being oil, phosphate rock, manganese ore, and salt.

The Nile provides the main transportation system for most of the Egyptians and their produce, but travel by camel, mule, and horseback also is common. There are, however, some railroads, airlines, and paved highways. Alexandria is the country's principal port; Cairo, its capital, is an important international airline center.

Early History. Egyptian history began about 3400 B.C., when King Menes of Upper Egypt conquered Lower Egypt and united the two already civilized states to form what is now known as the Old Kingdom. During the next some 3,000 years, the country was governed by thirty dynasties, or ruling houses, and had its periods of both splendor and decay.

Egypt's first spurt of greatness came during the Pyramid Age, which reached its peak between about 2900 and 2750 B.C. It was then that the finest of the pharaohs' mammoth tombs — the pyramids at Giza and to the south, near Memphis, then the capital — were built.

The Middle Kingdom, which lasted from about 2500 B.C. until 1580 B.C., also had its great era—under its famous twelfth dynasty. These rulers, who reigned from about 2000 B.C. until 1788 B.C., conquered Nubia to the south, increased Egypt's trade with foreign lands, and opened mines in the Sinai Peninsula. They also built a vast irrigation system along the Nile and drained Lake Moeris, south of present-day Cairo, then turned its fertile bottom into farms. The Fayum, as the district is called, is still Egypt's famous fruit and flower garden. This second period of greatness was also noted for its bronze wares and its literature. By 1650 B.C., however, the country had become so weak again that it was conquered by a people, probably Asiatic barbarians, whose rulers were called the Hyksos, or Shepherd Kings.

But about 1580 B.C., the nobles of Thebes drove out the Hyksos, and Egypt's New Kingdom began. Under its eighteenth and nineteenth dynasties, when such mighty pharaohs as Thutmose III, Seti I, and Rameses II reigned, a vast empire was built up. Egypt's golden age, the most glorious and prosperous of its long history, came at this time, when Nubia was reconquered and Palestine, Syria, and lands even farther east were brought into its empire. It was also during this period that Thebes was turned into the country's magnificent capital — a city of many fine temples, palaces, and monuments.

Although Rameses III, founder of the twentieth dynasty, was a strong ruler, Egypt's power and glory began to wane again about 1150 B.C. Then, in time, it became the conqueror's turn to be conquered — first by the Ethiopians, then by the warlike Assyrians (671 B.C.), by Nebuchadnezzar II of Babylon (605 B.C.), by Cambyses of Persia (525 B.C.), and by Alexander the Great of Macedon (332 B.C.). The Greek period that then began, ending the New Kingdom, became Egypt's fourth glorious era.

Under the Ptolemies. Although Alexander lived to found Alexandria as the capital and to introduce Greek culture into the country, he died only nine years after his victorious invasion. But Ptolemy, one of his generals, made himself pharaoh and founded the Ptolemaic dynasty that was to reign for nearly three centuries. Under these rulers, the country again became one of the earth's richest, most powerful nations; Alexandria, a great cultural center and the home of many of the ancient world's outstanding philosophers, scientists, and other scholars.

Roman Rule. In time, however, the Ptolemies became so weak that they had to seek Rome's protection — against their own dissatisfied, mistreated Egyptian subjects, as well as the foreign powers that constantly threatened to attack them. Only the personal influence of Cleopatra, last of this once-mighty dynasty, with Julius Caesar and Mark Antony enabled her to come to power. Then in 30 B.C. Antony, her lover, was defeated by Octavian, Cleopatra committed suicide, and Egypt became a Roman province. Nevertheless, Alexandria remained the chief center of Greek culture, second in greatness to Rome itself. Like the rest of the Roman Empire, however, Egypt gradually disintegrated, and its civilization practically died.

Moslem Egypt. Then in A.D. 640 the Arabs conquered the country, founded Cairo as its capital, and made it a center of Islamic culture. It was the Arabs who made Arabic the language of Egypt, established Mohammedanism as its chief religion, and gave its people their Moslem customs and traditions.

Except for brief periods, Egypt has been under Moslem rule ever since. At one time, Haroun al Raschid, of *Arabian Nights'* fame, ruled it from Baghdad. During the Crusades period, the great Saladin was its caliph. Under the Mamelukes (1250-1517), many of Cairo's most beautiful mosques and tombs were built, and both art and architecture flourished. But their defeat by the Turks in 1517 made Egypt a part of the slumbering, backward Ottoman Empire.

Modern Egypt. In 1798 Napoleon took the country, but after the French left in 1801, modern Egypt emerged from its long sleep under a new leader, the founder of Egypt's present line of kings. Albanian-born Mohammed Ali worked hard to extend Egypt's territory, to reform and modernize the country, and to restore it to its earlier position of wealth and power, but the independence he almost gained was only short-lived. When Said Pasha became ruler, railways were built and construction of the Suez Canal by the French was started. But Ismail, his successor, was forced in 1875 to sell Britain Egypt's shares in the canal because his spendthrift policies had bankrupted the country. In 1879 British and French pressure forced his abdication, and his son Tewfik was named khedive.

After that, France and Britain actually controlled Egypt until 1882, when British troops drove out the French and made their country its real ruler. The fiction that Egypt belonged to Turkey and was ruled by its own khedives lasted until Turkey entered World War I on Germany's side and was delegated to take or to destroy the Suez Canal. Angered by Khedive Abbas II's pro German sympathies, the British forced his abdication and openly declared Egypt to be the British protectorate it had really been.

In 1922, however, anti-British feeling in the country finally forced Britain to recognize Egypt as an independent sovereign nation, and its ruler, who had been called a sultan since 1914, became its king. Nevertheless, Britain reserved the right to keep troops there, to use Egyptian bases in case of war, and to handle all matters pertaining to the Suez Canal — all of which it did during World War II. Moreover, it was not until 1936 that Egypt began to be really independent.

Some fighting occurred there during World War II, but Egyptian troops were not involved, and Egypt did not declare war on the Axis until 1945, when it did so in order to join the United Nations.

Claiming a threat in the proposed new state of Israel, Egypt organized the Arab League in 1945. The Egyptians gained the Gaza and El Auja areas in a war with Israel in 1948-49. Egyptians agitated for placing of the Suez Canal and zone under Egyptian rule. In 1952, King Farouk I was deposed from the throne of Egypt, and Mohammed Naguib became premier. He started land reforms to give small tracts to Egypt's farmers. He declared Egypt a republic in June, 1953. In November, 1954, Gamal Abdel Nasser took over the

FIGHTING SHIP OF THE DESERT
On the sands of the desert, Egypt's camel corps is an efficient branch of the armed forces.

government. Renewed conflict began in 1955-56 between Egypt and Israel. The British evacuated the Canal zone in June, 1956, according to its agreement with Egypt of 1954. Nasser nationalized the Suez Canal in July, 1956. In October, the British and French, claiming the Israeli-Egyptian War a threat to shipping in the Canal, sent troops and planes into the Canal zone. The United Nations intervened, a cease-fire was arranged, and British and French troops withdrew in December. Nasser got arms, loans, and help with the High Assuan Dam from Russia. In 1958, Egypt and Syria formed a new nation, the United Arab Republic.

Also consult the following articles:

GEOGRAPHY

Alexandria
Assuan
Cairo
Delta
Heliopolis
Luxor
Memphis
Nile
Pharos
Sinai
Suez Canal
Thebes

HISTORY

Alexander the Great
Alexandrian Age
Antony, Mark
Augustus
Caesar, Caius Julius
Cleopatra
Exodus
Khartoum
Kitchener, Horatio
Mamelukes
Napoleon
Nebuchadnezzar
Pharaoh
Ptolemy
Tutankhamen
World War (I, III)

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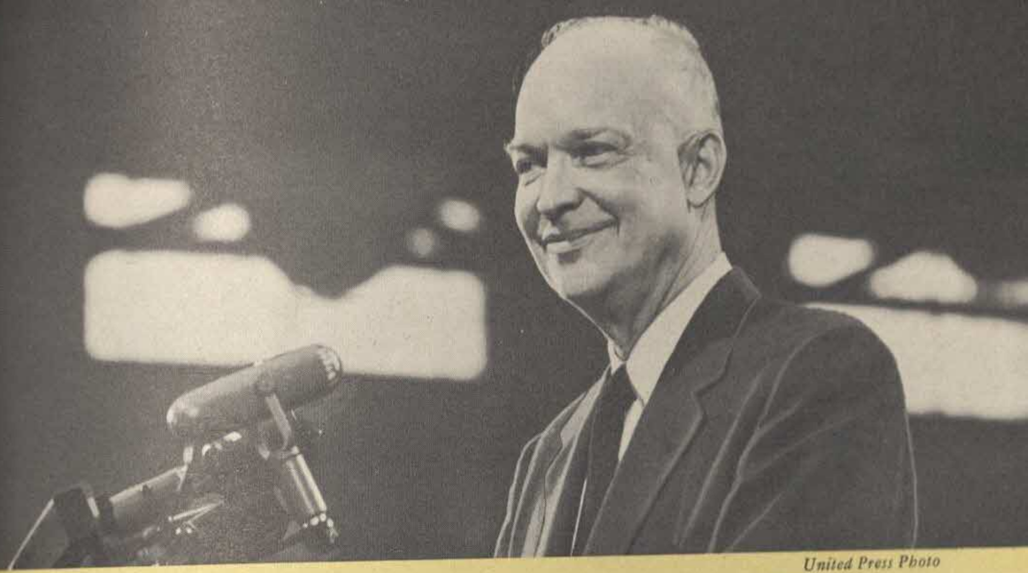
Pyramids
Re
Rosetta Stone
Scarab
Sculpture
Sphinx

EIN′STEIN, ALBERT (1879-1955). When Einstein's first paper on his theory of relativity was published in 1905, he was an unknown clerk in the Swiss patent office. Yet the theory he had thought out in his spare time was to rank him as one of the world's greatest mathematicians and physicists. Not since Sir Isaac Newton published the laws of gravitation late in the seventeenth century has any scientific discussion caused so much discussion. Physics, astronomy, and chemistry have been affected by Einstein's theory, and it has stimulated scientific investigation in many fields.

Einstein was born at Ulm, Germany, grew up in Munich, and at fifteen moved to Switzerland. When his first paper on the theory of relativity was published in 1905, he was working in the patent office at Bern. Continuing his studies, he received his Ph.D. at the University of Zurich and became a member of its faculty. Later he taught at the German University at Prague, at the Kaiser Wilhelm Institute, the Royal Prussian Academy of Sciences, and the University of Berlin. In 1921 he was awarded the Nobel Prize in Physics for his achievements.


United Press Photo

THIRTY-FOURTH PRESIDENT OF THE UNITED STATES
President Eisenhower was the first Republican to gain the White House in twenty years.

On a lecture tour when Hitler came to power in Germany, Einstein, a Jew, a pacifist, and an internationalist, sought refuge in Belgium. Later he accepted an invitation to become professor of mathematics at the Institute for Advanced Study in Princeton, N. J. Here he found safety and time to pursue his research, to play his violin, and to promote Zionism, world government, and other causes he favored. He became an American citizen in 1940.

Relativity. Einstein published the special theory of relativity in 1905 and the general theory in 1916. One of two fundamental assumptions in the special theory is that uniform straight-line motion of a body relative to an assumed framework in space cannot be detected (see ETHER). That is, we cannot measure "absolute" motion of the earth in space, but only its motion relative to other bodies, such as the sun. The second assumption is that the speed of light in vacuum or in empty space is the same for all observers and is not affected by motion of the source or of the observer.

One conclusion from the special theory, that mass and energy are equivalent, is verified in "atom-smashing" experiments and in the conversion of mass to energy in atomic-bomb explosions. Another, that the mass of a body increases as its speed increases, relative to an observer at rest, is verified for atomic particles with speeds comparable to the speed of light; at 161,000 miles a second, theory says mass is doubled and lengths in the direction of motion are halved.

According to the general theory, gravitational phenomena result from curvature of space near matter, not from forces of attraction. Its predictions of effects near great masses differ from those of Newton's theory, but have been verified: that is, light rays passing close to the sun are deflected; lines in the sun's spectrum are shifted slightly; and rotation of Mercury's orbit is explained.

EISENHOWER, DWIGHT DAVID (1890-). In 1952 some 55 per cent of America's voters elected Dwight D. Eisenhower the thirty-fourth President of the United States. As in the elections of Zachary Taylor and Ulysses C. Grant, the nation had selected a professional soldier and popular military hero as its Chief Executive.

Born in Denison, Tex., Eisenhower grew up in Abilene, Kan., where he acquired the nickname "Ike." A good student, he graduated from West Point in 1915. He trained troops in World War I and then attended various officers' schools.

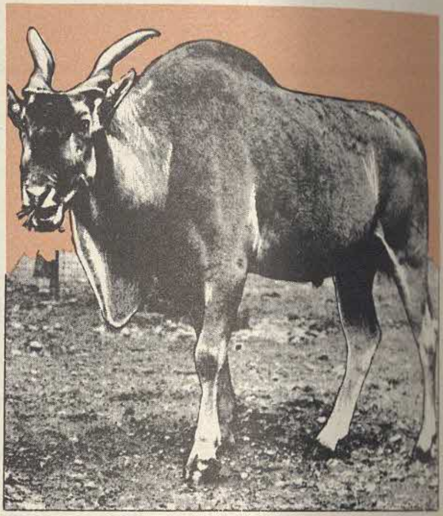
In the 1930's, he was assistant to Army Chief of Staff General Douglas MacArthur, and spent years in the Philippines. At the outbreak of World War II, Eisenhower was made assistant chief of the war plans division. In the summer of 1942, General George C. Marshall, Army Chief of Staff, placed him in command of the European Theater of Operations. He commanded the Allied invasion of North Africa, and the campaigns in Sicily and Italy.

As commander of Supreme Headquarters of the Allied Expeditionary Forces (SHAEF) after January, 1944, Eisenhower began uniting Allied forces for the invasion of Normandy and the defeat of Germany. See World War II.

After the war ended, in 1945, he commanded occupation forces in Germany, then returned home to succeed General Marshall as Army Chief of Staff. In 1948, he resigned and accepted the presidency of Columbia University. His book on the war, *Crusade in Europe,* was published in 1948. At President Truman's request, he took command in 1951 of Supreme Headquarters, Allied Powers in Europe (SHAPE), to organize military forces for the North Atlantic Treaty Organization (NATO).

As Republican candidate in 1952, Eisenhower was elected President, with Richard M. Nixon as Vice President. The electoral vote was 442 for Eisenhower to 89 for Adlai E. Stevenson. In 1956, Eisenhower and Nixon were re-elected by an even greater majority. Major aims of the Eisenhower administrations were: economy in government and control of inflation; economic relief for distressed nations; international reduction of armament, especially atomic weapons; and world peace. See also United States of America.

E'LAND. This African antelope is as large as a full-grown horse. It is hunted for its hide, which is used in making harness, and for its flesh, which is considered a table delicacy. Because it is so highly valued and is gentle and easily captured, the eland is rapidly becoming extinct. See Antelope.



LARGEST ANTELOPE
The eland, which grows to a height of six feet. The animal is native to South Africa.

ELASTICITY, *e las tis' i te.* A body that will resume its original shape or volume, after a force tending to distort it has been removed, is said to be *elastic,* or to have *elasticity.* Almost all substances are somewhat elastic, but some are much more elastic than others. Steel, glass, wood, and rubber are examples of elastic substances. Liquids and gases are elastic as to volume, but not as to shape. Lead, mortar, clay, and others are so slightly elastic that they are said to be *inelastic.*

Elasticity is due to molecular forces of attraction and repulsion. The stretched rubber tends to contract because of the cohesion between its molecules. The compressed gas tends to expand because of a force due to numerous impacts of the rapidly moving gas molecules. An automobile tire is elastic not only because of the rubber, but chiefly because of the air it contains.

Elasticity plays a very important part in the work of men and machines. It takes away sudden shocks through springs on vehicles and through rubber soles on shoes and wheels; it stores energy for immediate use in the spring of an eight-day clock. And it permits floors and wooden bridges to sag without breaking, so that they do not suddenly rupture without warning. It also permits the walls of our houses to contract when it is very cold, without cracking, as the ground does. See COHESION; EXPANSION.

EL'BE. Winding down the slopes of the Silesian Mountains in Czechoslovakia, the Elbe River flows past Dresden, Wittenberg, and Hamburg. The huge commerce of these cities makes the river one of the most important in Europe. Ocean-going steamers ply the Elbe as far as Hamburg, which is Germany's chief port and one of the world's greatest ocean ports. The river is 725 miles long, and its commercial importance is increased by many canals. Its chief tributaries are the Moldau, which flows into it from Central Europe, the Eger, the Saale, and the Mulde.

ELDER. Bearing black or red berries sometimes used in making pies and wine, the elders are small trees or shrubs that produce large clusters of small white flowers and opposite leaves with sawlike edges. Some kinds of elder are used in landscape gardening because of their beautiful foliage and blossoms and handsome appearance. The wood of the North American elder is too soft to be of commercial value. That of European elders, however, is used in making articles requiring a hard, polished wood.

ELECTION, *e lek' shun.* The President of the United States, Congressmen, Senators, and most other public officials obtain their offices through the choice of the majority of voters. This process, which should be familiar to every citizen of a country, is called an election. Although in a democracy offices are filled, in general, by popular vote, there is a growing tendency to fill lesser offices with men appointed either by a capable head or chosen through examinations of merit (see CIVIL SERVICE). The policy-forming positions are still filled by election on the principle that the people have the right to put their desires into effect and to appoint men to represent their views.

In America, there are safeguards to protect the voter from undue outside influence and to guarantee him as much freedom as possible in casting his vote. However, there are countries in which voters go to the polls under subtle threats or military persuasion. Very few countries make voting compulsory. The right to vote is a privilege of every citizen of the United States.

For secret voting, the Australian ballot is widely used. This method prevents voters from bringing in or taking out ballots from the polling place. Elections as a rule are decided in favor of the one receiving the highest number of votes. However, several methods, such as the Hare and Grand Junction systems, have been tried for the purpose of obtaining true majorities. Under the Grand Junction voting system, the voter marks three choices—first, second, and third—and as the low men are eliminated in the count, the voter's choice is transferred to another candidate. Voting machines and "short" ballots are becoming increasingly popular in cities where ballots tend to be very long.

Requirements. Citizenship is generally a requirement for voting. There are exceptions in some states, where individuals in the process of becoming citizens may vote. Women may vote in national elections in the United States under the Nineteenth Amendment. The Federal Constitution provides that any person qualified to vote for state representatives is qualified to vote for all members of Congress. In most of the states a person must be twenty-one years old before he may vote. In no state may a mentally defective person do so. Several states have poll taxes which must be paid before a citizen may vote.

Residence requirements are also important. If a person moves from one state to another, a year's time is usually required before voting in state elections is permitted. Smaller units — counties, cities, wards — have varying short-time residence requirements.

Special Elections. Elections are often held for other reasons than to fill offices.

They may be used to change provisions in the Federal or state constitutions, either directly or by the selection of representatives to meet in convention and carry out the wishes of the people. Cities, villages, counties, and other governmental units hold elections to approve money-raising ventures, to provide roads, sewerage disposal, public schools, etc. The initiative, referendum, and recall are now popular in the election systems of most states. Under the right of the *initiative,* citizens themselves can introduce legislation for general approval. Under the *referendum,* the public is given the right, by voting, to approve or disapprove acts of the legislative bodies. If a public official does not meet public standards for an office which he is holding, he may be *recalled* from that office by popular vote.

Political parties may select candidates by a meeting or caucus, or candidates may announce their own candidacies. Several are usually chosen to represent each party for any office to be filled. These candidates are then placed before the party voters for final choice. This balloting is called a primary election, and in most cases precedes the general election by two months.

In the United States, Presidential elections take place on the first Tuesday after the first Monday in November. Sunday is a popular day in foreign countries, since it assures workers of an opportunity to vote without the necessity of declaring a special holiday.

Consult the following titles for additional information:

Ballot
Citizen
Electoral College
Initiative
Naturalization
Primary Election
Recall, The
Referendum
Voting Machine
Woman Suffrage

ELEC'TORAL COLLEGE. When the people of the United States vote in a Presidential election, they do not vote directly for the man they wish for President. Instead, they vote for a group of men listed on the ballot under each political party. These men, or electors, make up the electoral college for each state. They meet at a future time, on the first Monday after the second Wednesday in December, and vote by ballot for President and Vice President, who must be residents of different states. The ballots are submitted to the president of the Senate, who opens them before both houses of Congress assembled on January sixth. They are there counted, and the person receiving the majority of the whole number of electoral votes is officially declared President.

The process described is, in theory, what takes place in a Presidential election, according to the provisions of the Constitution. Actually, however, people do not think of the electors when they cast their vote. The name of each candidate appears at the top of the ballot, with the names of the electors beneath, and a mark beside the name of the candidate usually elects the entire slate of electors of the party. The founding fathers intended that the electors should have some freedom of choice in casting their votes. However, today the parties nominate the electors and they are instructed to vote for their party candidate when the electoral college convenes. The meeting of the college has become simply a traditional formality, as the country generally is aware of the people's choice for President within twenty-four hours after election day.

If no candidate for President receives a majority of votes in the college, the House of Representatives must choose one of the three persons receiving the highest number of votes. The Senate then selects the Vice-President.

No member of Congress or person holding an office of the United States can be chosen as an elector. The number of electors in each state is equal to the total delegates that the state has in both houses of Congress. The date that electors are chosen is the same in all states, the first Tuesday after the first Monday in November.

ELECTRICAL FISH. There are several kinds of fish capable of giving an electrical shock, the best known being the electric eel

LIVE BATTERIES

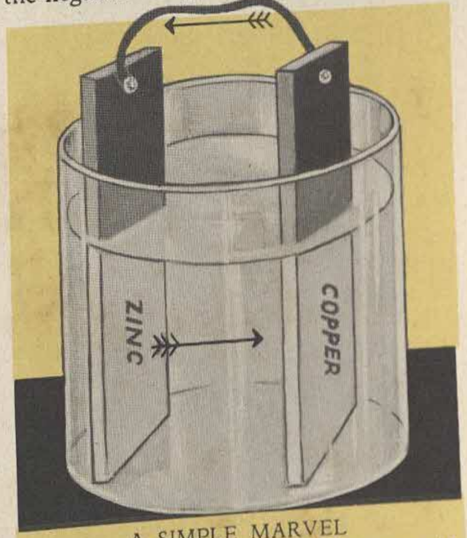
Several kinds of fish carry charges of electricity, with voltages as high as 200 (in the electric eel). The "juice" is generated in peculiar muscle cells. Left, the electric catfish of the Nile. Right, the electric ray, a flat triangular South Sea fish carrying about thirty-five volts.

found in the waters of South America. The body of this eel is bluish gray, smooth, and of uniform thickness, and it often grows to be six feet long. A kind of catfish that lives in the Nile River can also give electric shocks. The torpedo fish, found on the east coast of the United States, possesses this power. The organs that give the shock are located in various parts of the body in different species. After several discharges of electricity, the current is weakened, and the fish must rest in order to store up new force.

ELECTRIC BATTERY. One of the principal sources of electricity today is the electric battery, a device composed of one or more cells, each of which produces a current of electricity by chemical action. Each cell is made up of a container, a chemical solution known as the *electrolyte,* and poles of two different metals, or a metal and carbon, known as *electrodes.*

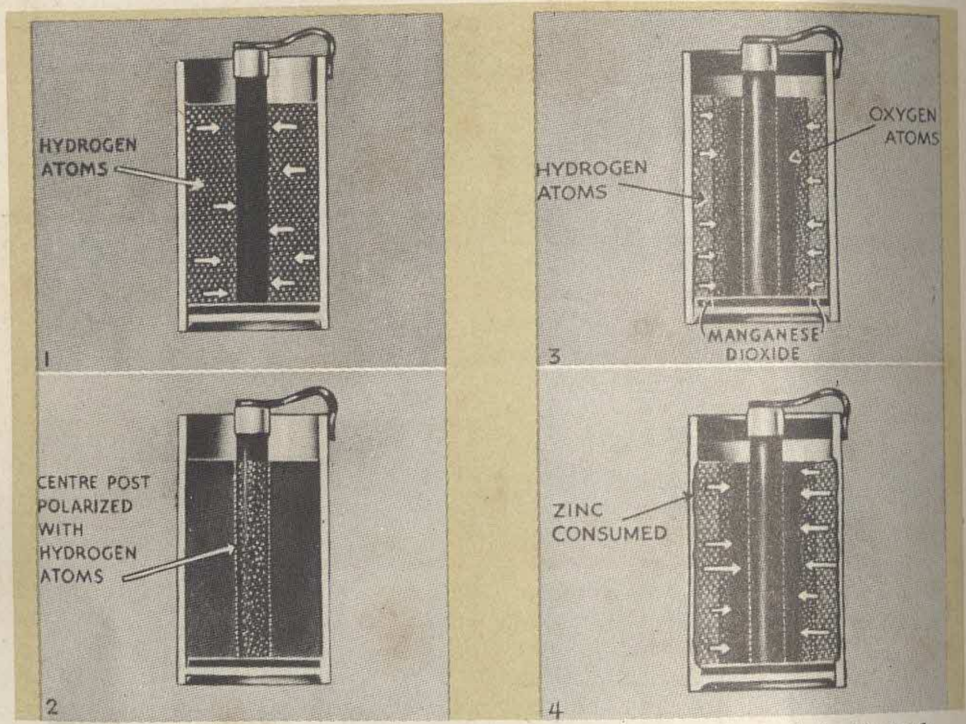
How a Simple Cell Works. One of the simplest of electric cells may be made by stirring a tablespoonful of concentrated sulphuric acid into a glass of water and placing a strip of copper and one of zinc in the solution. To each of these strips is connected a small, bare, copper wire. When these two wires touch, a current will flow. If the bare ends of the wires are placed on the tongue, a peculiar taste will be noticed immediately, owing to the chemical action produced by the current.

In this simple cell, the copper has a positive charge, the zinc a negative charge. When the wires are connected, current is said to flow from the positive, or copper, electrode to the negative, or zinc, electrode. Actually, however, science has shown that the negative charges, or electrons, move in



A SIMPLE MARVEL

The four elements of a wet-cell battery: acid, water, and two metals. The reaction which takes place produces current in the wire.



Courtesy National Carbon Co.

THE INSIDE STORY OF A DRY BATTERY

The cell consists of a zinc can, a carbon positive post, and electrolyte paste. The paste consumes the zinc, producing a current which flows toward the post. Hydrogen atoms must be prevented from accumulating and polarizing the post, so oxygen-producing manganese dioxide is put in; its oxygen attracts the hydrogen, and the current continues.

the opposite direction through the wire, from zinc to copper. In such a cell, the zinc will dissolve in the acid, releasing electrons and forming a new compound, zinc sulphate, which will remain in the solution.

Briefly, the chemical action is this: The zinc immersed in the acid becomes ionized and dissolves, causing zinc ions to go into solution and leaving electrons on the zinc plate, which becomes negatively charged as a result. A flow of electrons takes place through the wires over to the copper plate, where hydrogen ions take them up and form bubbles of hydrogen gas. These bubbles will soon form a coating on the copper plate, however, gradually setting up a resistance which cuts down the current. When the pole is coated like this, it is said to be *polarized,* and eventually the cell will cease to produce electricty. In commercial cells, however, polarization is avoided by adding other chemicals to the electrolyte.

Other simple cells may be made by inserting a stick of carbon and one of zinc into a strong solution of sal ammoniac (ammonium chloride). Another type of cell, now out of use, is the gravity battery, made by inserting copper and zinc electrodes in a solution of copper sulphate (blue vitriol) and zinc sulphate. This battery, formerly used in telegraph work, has been replaced by line power for such work.

Few of these cells have any practical uses. They are constructed chiefly to show just how electrical current is created in a simple battery.

The Common Dry Cell. Flashlights, bells, buzzers, and even some small radio sets usually operate from batteries known as *dry cells.* Strange as it may seem, they are not actually dry but consist of a zinc cup lined with blotting paper and containing an electrolytic paste, a solution of sal ammoniac and manganese dioxide. In the center of the battery is placed a carbon pole, and over the top is poured melted tar or sealing wax to close the cell and prevent spilling and evaporation. The chemical action, however, is essentially the same as in the simple cell already outlined. With the exception of the storage battery, such as is used in an automobile, the dry cell is the most common battery in use today.

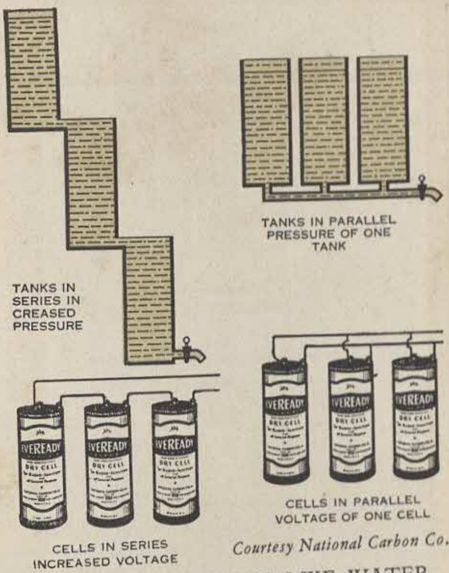
The Storage Battery. All batteries are either *primary* or *secondary*. Primary batteries, such as those explained above, are so-called because new materials have to be used for each cell; and when the chemicals are exhausted, the battery is useless.

Secondary, or storage, batteries, are of much longer life and, when exhausted, can be charged over and over again. Charging is accomplished by connecting the batteries to a dynamo, which sends direct current into them in the direction opposite to that in which the battery delivers current.

A simple storage cell may be built by placing two sheets of lead in a glass jar containing a solution of one part of sulphuric acid to four parts of water. If four dry cells, connected in series, are then connected to this cell, it will become charged. Bubbles will appear on both plates, one of which will turn brown. If an electric bell is then connected to the storage cell, the bell will ring for some time.

Large storage batteries have both lead and lead-oxide plates, each pair insulated by a wood separator. As the battery "runs down," both plates change to lead sulphate. Recharging will return both plates to their original form. Such batteries change their chemical energy into electrical energy; and when they are being recharged, electrical energy is changed into chemical energy. Storage batteries, then, do not store electricity, but chemical energy.

These batteries are used in automobiles, trucks, and airplanes for starting, lighting, operating the radio, and blowing the horn.



Courtesy National Carbon Co.

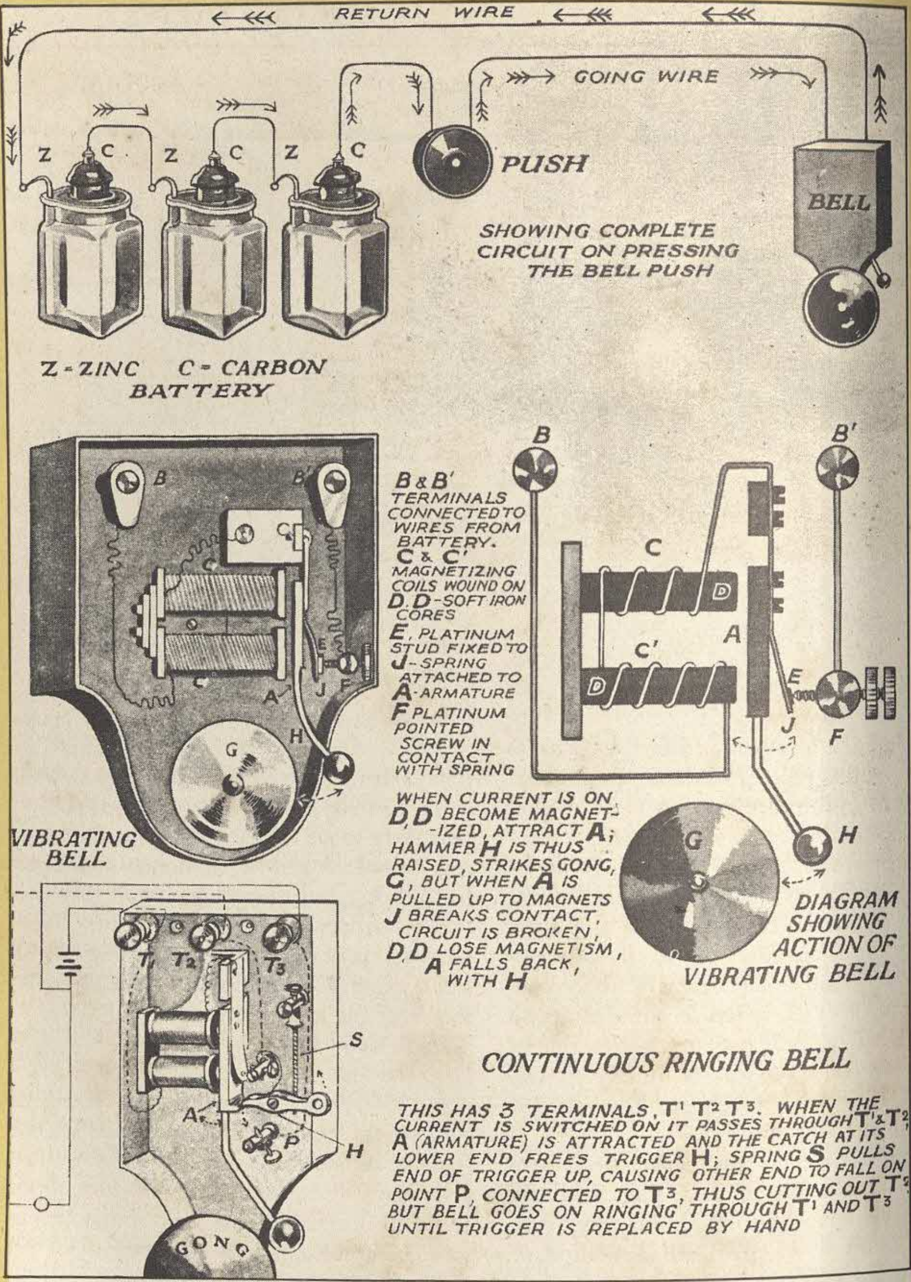
ELECTRICITY FLOWS LIKE WATER

Batteries must be connected in *series* to increase voltage or pressure; in *parallel* to produce longer supply.

They furnish power for operating submarines, driving electric cars and trucks, and operating mine locomotives and small lifting cranes. Many farm homes use them for lighting and maintain a small gasoline-driven dynamo to recharge them. Every automobile does its own recharging with a small generator that operates whenever the motor of the car is running.

How Cells Are Connected. Let us suppose that we have four dry cells to connect. There are two possible methods. In connecting them in a series, we attach the positive of one to the negative of the next, and so on. Since each cell generates about one and one-half volts, four connected in series would provide a total output of six volts.

When connecting is done in parallel, all the positive poles are connected, and the same applies to the negatives. This gives us a total of only one and one-half volts, the same as for a single cell; but the flow of current will last about three times as long. The connecting method used depends upon the purpose for which the cells are to be used. See ELECTRICITY.

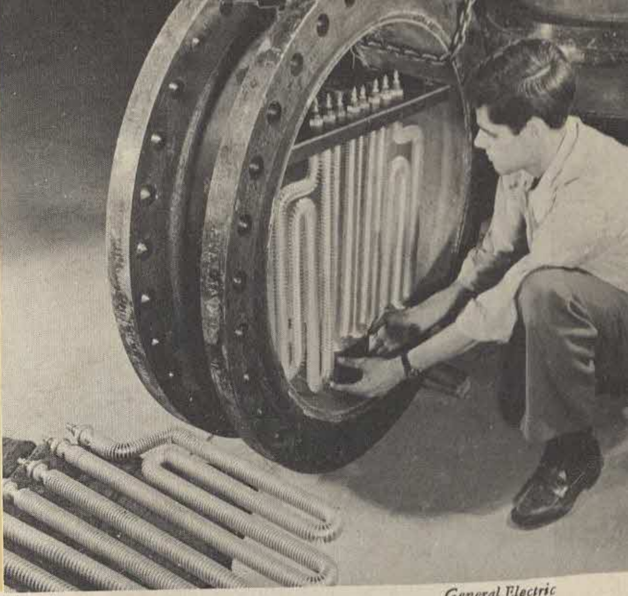

RETURN WIRE
GOING WIRE
Z C Z C Z C
PUSH
BELL
SHOWING COMPLETE CIRCUIT ON PRESSING THE BELL PUSH
Z = ZINC C = CARBON
BATTERY
B B' C C A E J F H G
VIBRATING BELL
B & B' TERMINALS CONNECTED TO WIRES FROM BATTERY.
C & C' MAGNETIZING COILS WOUND ON
D, D - SOFT IRON CORES
E, PLATINUM STUD FIXED TO
J - SPRING ATTACHED TO
A - ARMATURE
F PLATINUM POINTED SCREW IN CONTACT WITH SPRING
WHEN CURRENT IS ON D, D BECOME MAGNETIZED, ATTRACT A; HAMMER H IS THUS RAISED, STRIKES GONG, G, BUT WHEN A IS PULLED UP TO MAGNETS J BREAKS CONTACT, CIRCUIT IS BROKEN, D, D LOSE MAGNETISM, A FALLS BACK, WITH H
B B' C C' D D A E J F G H
DIAGRAM SHOWING ACTION OF VIBRATING BELL
T1 T2 T3 S A P H
GONG
CONTINUOUS RINGING BELL
THIS HAS 3 TERMINALS, T1 T2 T3. WHEN THE CURRENT IS SWITCHED ON IT PASSES THROUGH T1 & T2; A (ARMATURE) IS ATTRACTED AND THE CATCH AT ITS LOWER END FREES TRIGGER H; SPRING S PULLS END OF TRIGGER UP, CAUSING OTHER END TO FALL ON POINT P, CONNECTED TO T3, THUS CUTTING OUT T2 BUT BELL GOES ON RINGING THROUGH T1 AND T3 UNTIL TRIGGER IS REPLACED BY HAND

ELECTRICITY SOUNDS THE ALARM

Nearly all our sound signals today are some form of the electric bell. These devices call us to the telephone, the door, the class, and any number of places. They hail elevators and stop streetcars. They call nurses to sickrooms and police to scenes of crime. This is how they work. Wet-cell batteries are shown, but, of course, bells will ring on any kind of current. At the bottom is a bell which keeps on ringing indefinitely once the current has been introduced. These are for burglar alarms, and must be reset before they will quiet down. But whatever the type or purpose, bells work according to the principle of "making and breaking" the electrical circuit, as shown in the diagram (right). The hammer is moved by current which automatically starts and stops.

HOT OFF THE WIRE

In industries and in homes, electric heating is becoming increasingly popular. It is easily controlled, clean, and does not require a venting flue. Thousands of homes are heated electrically. This operator is installing finned electric heating coils for use in high pressure air heaters. The fins permit better distribution of the heat.



General Electric

ELECTRIC BELL. One of the most familiar electrical devices in use today is the electric bell. It is used in the home for the doorbell and the telephone, in offices and factories to summon persons at a distance, in school as a class bell, in fire and burglar alarms, and in countless other ways. Essentially the electric bell consists simply of a set of electromagnets, an armature, and a gong, or of two gongs in case of telephone bells. How it operates is explained in the accompanying diagram.

ELECTRIC CLOCK. Mass production has so reduced the cost of electric clocks that they no longer are considered a luxury; rather, they are almost a necessity. Today they are found in millions of homes.

Early electric clocks were really spring clocks that were wound by motors or electromagnets at regular intervals. But like the spring alarm clocks of today, they were likely either to gain or lose time.

Modern Electric Clocks. The electric clock of today is driven by a small synchronous motor which runs in unison with the pulsations of the 60-cycle alternating current used in most cities. Its accuracy is due to the fact that most power stations very carefully control the speed of their generators. A few of the more expensive home electric clocks are equipped with an electric-wound spring mechanism which will operate the clock for short periods, should the current stop.

Some electric clocks are automatically regulated every hour by a master clock at a central point. Other types operate by magnetic control, the hands moving when electric impulses are received from the master clock.

ELECTRIC EYE. See PHOTOELECTRIC CELL.

ELECTRIC HEATING. Electric irons, curlers, toasters, waffle irons, and heating pads work because of the same principle—resistance. In electricity, resistance means the opposition of a substance against the passage of a current. All substances, even copper and silver, the best conductors, resist the passage of current to some extent. The electric current, in passing through, must fight against this resistance; and, as a result, heat is produced.

The amount of heat produced depends upon the substance used as a conductor, the amount of current forced through, and the time the current flows. If one wire has twice the resistance of another, it will give off twice as much heat for the same current. If two wires have the same resistance, but twice the current is forced through one of them, four times the heat will result in the wire with the greater current. And if both current and resistance are doubled in a wire, the heat will increase eight times.

The kind of conductor used for the current depends upon what use is to be made of it. If little heat is desired, copper or aluminum wire of low resistance is used. But if great heat is wanted, wires having high resistance are used. In heaters, electric irons, and toasters, for instance, coils of high-resistance wire (usually nichrome wire) are used to produce concentrated heat at certain points. Heating elements are usually in the form of rods or coils. The filament in an electric light offers such high resistance to the passage of the current that it is heated to incandescence, thereby producing the light so familiar to all of us.

Fuses, too, operate on a similar principle, for if the current passing through them is too heavy, they become so hot that they melt; thus the wiring within a building is protected, and short circuits and fires are prevented. Because of the high cost of current and the great amount needed, houses are not generally heated electrically.

Electric Furnaces and Their Uses. Wherever an intense heat ranging up to 6,000° F. is needed, electric furnaces are used. Such equipment may be of three types: arc furnaces, resistance furnaces, or induction furnaces.

Arc furnaces are equipped with large carbon rods, which are brought together and then separated. The current then "arcs" across the small gap, and an intense heat is generated, capable of melting high-grade steel and other metals.

Resistance furnaces, like electric irons, produce heat by the passage of current through high-resistance wire — platinum, tungsten, nichrome, or other metals.

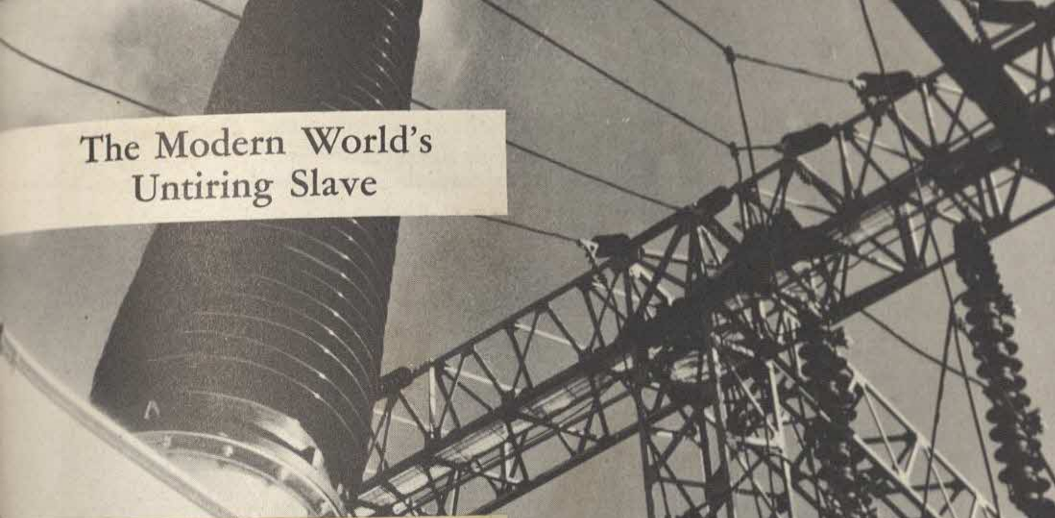
Induction furnaces use high-frequency alternating currents, which pass through coils of high-resistance wire around the material to be heated. Around this wire a magnetic field is created which induces strong currents into the material, raising its temperature greatly. See ELECTROMAGNETISM.

Courtesy Westinghouse

THE TIRELESS MAGIC SERVANT IN THE HOME

Electric heat and power are the modern genii that can do almost anything. Many of today's kitchens are all electric. Among the modern devices are an electric washing machine (left) and an electric ironer (right). How different from the backbreaking methods of old!

The Modern World's Untiring Slave



General Electric Co.

A CAPTURED GIANT

Once a spark on Ben Franklin's kite, electrical power now serves man in a multitude of ways.

ELECTRICITY. One of the strangest things in modern science is electricity. Just what it is, scientists cannot say, yet the wonderful things it does affect almost the whole of our daily lives. Though we do not know what electricity is, we do know its effects and how to control them; and this knowledge, as it increases, produces for us an almost countless number of marvelous devices to make life easier, work lighter, and the world a better place in which to live.

Electricity in Our Daily Lives. Modern life, indeed, is practically dependent on this giant from the dynamo. Our larger cities would be completely paralyzed, transportation cut off, water supply endangered, communications severed, and industries crippled should all electrical power be cut off for even a single day.

One of the most useful of electricity's duties is the artificial regulation of climate. Through air conditioning, the proper heating, cooling, circulating, cleaning, and moistening of the air we breathe is brought about. Electricity cooks our foods, furnishes us with hot water, regulates the temperature of incubators, and protects hotbeds of the farmer. Temperatures may, on the other hand, be lowered by electrical refrigeration, saving us thousands of dollars in preventing food spoilage, protecting flowers, safeguarding the dairy's milk supply, and freezing thousands of gallons of ice cream daily. Electrically produced ultraviolet and infra-red rays are used to furnish Vitamin D, to build solid bones and teeth, to help relieve pain, and to contribute to our health in numerous other ways. Through the electric light in its various forms, our vision is safeguarded, highways made safer, and many conveniences made possible.

Radio, television, and public-address systems carry voices and music to people

Westinghouse Electric and Mfg. Co.; Radio Corporation of America

MIGHTY TRAINS AND MICROSCOPES
Electricity can be put to work in a tremendous variety of ways. It powers the locomotive above and the electronic microscope at left.

at a distance. Electric organs resembling the pipe organ, but costing thousands of dollars less) and burglar-alarm systems protecting banks, offices, factories, and homes are all modern examples of electricity's service to us in producing sound.

Industrially, electricity hardly has a rival, for it performs tasks impossible to any other source of power. Electric motors, electric furnaces, special lighting systems, photoelectric cells (the "electric eye" of a thousand uses), and insect destroyers are all outstanding examples of electricity's value to industry.

In the home, stoves, heaters, toasters, percolators, irons, washers, radios, refrigerators, and fans lighten the labor of the housewife and contribute to family comfort and happiness.

Even our leisure time has been made much more enjoyable through electricity. The automobile, depending upon electric ignition and lighting; floodlighting, with its resulting "daylight" so popular for night sports (including football, basket ball, tennis, and even baseball); moving pictures, and the photoelectric cell used in the "timing" of races are but a few examples of electricity's contribution to recreation.

Health and beauty are also indebted to this strange force. The ultra-violet and infra-red rays, already mentioned, play an important part in this field. So does electrotherapy, the treatment of disease through the application of heat. X-rays, stethoscopes, and sterilizers are all important parts of the doctor's equipment for keeping people well. To the beauty parlors, electricity brings driers, wavers, curlers, pads, exercisers, and a host of other devices for the treatment of the hair, skin, and body.

The decorative lighting effects and brilliant and spectacular neon signs seen in our larger cities owe their very existence to electricity.

Nor is this a complete list. Undoubtedly, to the hundreds of electrical servants now in existence will be added a great many new ones, to come through the efforts of the electrical engineer and chemist.

Development. No one can be sure of the exact time when electricity was discovered. It is known, however, that the Greeks as early as 600 B. C. found that by rubbing an amber rod with fur or cloth, it could be made to attract dry sawdust or bits of paper. Amber was known to the Greeks as *elektron,* and from that word electricity was given its name in the year 1600 by an Englishman, Dr. William Gilbert.

From 600 B. C. until the latter part of the eighteenth century, relatively little advancement in electricity was made. At that time, Benjamin Franklin discovered that lightning and electricity are one and the same. To Franklin also goes the credit for intro-

Courtesy Westinghouse Electric and Mfg. Co.

ELECTRIC BEAUTY

Chicago's great Merchandise Mart glows nightly in the light of hundreds of floodlights.

SOME USES OF ELECTRICITY

Temperature Control
- Air Conditioners
- Heaters
- Furnaces
- Incubators
- Refrigerators
- Hotbeds

Lighting
- Home Illumination
- Highway Lighting
- Flood-lighting
- Electric Signs
- Photograph Lighting

Sound
- Public-Address Systems
- Electric Organs
- Radio
- Television
- Electric Bells
- Buzzers
- Chimes

Industry
- Motors
- Electric Furnaces
- Photoelectric Cell
- X-Rays
- Office Equipment
- Ore-prospecting Equipment
- Insect Killers
- Lifting Magnets
- Factory Lighting
- Electric Timers
- Cranes
- Hoists
- Shovels

Home
- Toasters
- Ironers
- Washers
- Stoves
- Heaters
- Blankets, sheets
- Vacuum Cleaners
- Fans
- Kitchen Accessories
- Clocks
- Percolators
- Hot Pads
- Dishwashers
- Door Bells
- Garbage Disposers

Health and Beauty
- X-Rays
- Infrared Rays
- Ultraviolet Rays
- Electrotherapy
- Electrocardiographs
- Electron Microscopes
- Driers
- Clippers
- Vaporizers
- Sun Lamps
- Exercisers
- Permanent Wavers

Transportation and Communication
- Electric Railways
- Automobile Ignitions
- Telephones
- Telegraphs
- Submarine Cables
- Radar
- Escalators
- Elevators

MAKING PAPER DOLLS DANCE

By rubbing the piece of glass, a shortage of electrons is produced, and the tendency to restore the balances causes the dolls to jump up.

ducing the terms *negative* and *positive* to describe two electrical states that can be produced by a simple experiment. If a stick of sealing wax is rubbed with wool, it can be made to attract a ball of pith suspended on a silk thread. After clinging to the wax for a time, the ball will be vigorously repelled.

A glass rod rubbed with silk attracts the ball and then repels it; but two glass rods rubbed with silk will repel each other. From these and other similar experiments one of the basic laws of electricity is deduced: "Like charges repel, while unlike charges attract, each other." It is customary to call the electrical charge formed by rubbing sealing wax with wool, negative; and that induced by rubbing glass with silk, positive.

The Electron Theory of Electricity. One of the early ideas by which scientists attempted to explain electricity was that every substance was made up of two weightless fluids. If it had more of one than the other, it was said to be positively charged; if the reverse was true, it was said to be negatively charged. Later theories maintained that there was but one such fluid, and that bodies having too much of it were positively charged, while if too little of it were present, they were negative. The electron theory of today has a slight similarity to the "one-fluid" theory, for it is known that negatively charged bodies have an excess of electrons, while positively charged bodies are deficient in them.

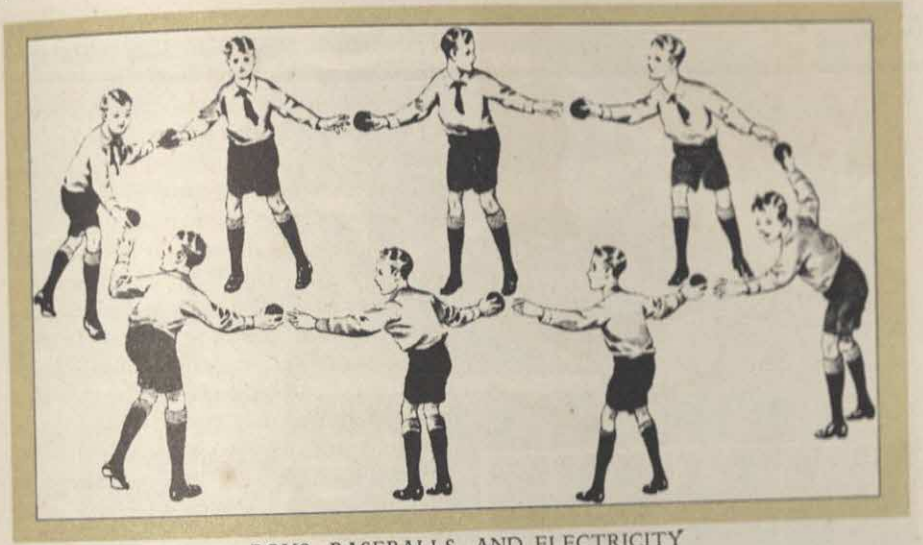
These tiny negative particles of electricity are so small that it requires about 1,800 of them to equal the weight of one hydrogen atom. Moreover, scientists believe that they form a part of all atoms, and that they revolve about a heavier positive nucleus (see CHEMISTRY for a fuller description of the atom). Rubbing the wax with a piece of wool causes the wax to take negative electrons from the wool, leaving the wool positive and making the wax negative. However, just as theories have changed in the past, this new electron theory may be modified or changed in the future.

Conductors and Non-Conductors. A substance that allows the passage of electricity with little difficulty is called a *conductor*. Other materials resist the flow of current completely or nearly so. Such materials are known as *non-conductors* or *insulators*. Among the better-known conductors are various metals such as copper, silver, mercury, aluminum, iron, and platinum. Among the non-conductors are glass, sealing wax, and rubber.

CONDUCTORS AND NON-CONDUCTORS

Metallic Conductors	Non-Metallic Conductors	Non-Conductors
Aluminum	Carbon	Bakelite
Brass	Coke	Diamond
Copper	Copper Sulphide	Dry Air
Gold	Graphite	Glass
Iron	Selenium	Mica
Magnesium	Silver Sulphide	Paraffin
Molybdenum	Water solutions of salts, acids, and alkalies	Porcelain
Silver		Rubber
Sodium		Shellac
Tungsten		Silk
Zinc		Wool

Static Electricity versus Electric Currents. There is no essential difference between *static electricity* and an *electric current* except those properties which the latter acquires by reason of the motion of the electrons. An electric current is a stream of innumerable electrons passing



BOYS, BASEBALLS, AND ELECTRICITY

Electricity flowing through a circuit is like a number of baseballs being passed around a circle. Each boy represents an atom of the conductor, and each baseball an electron of each atom. At a signal, each boy passes his baseball to the right, gets one from the left. Without affecting balance, a current is set up.

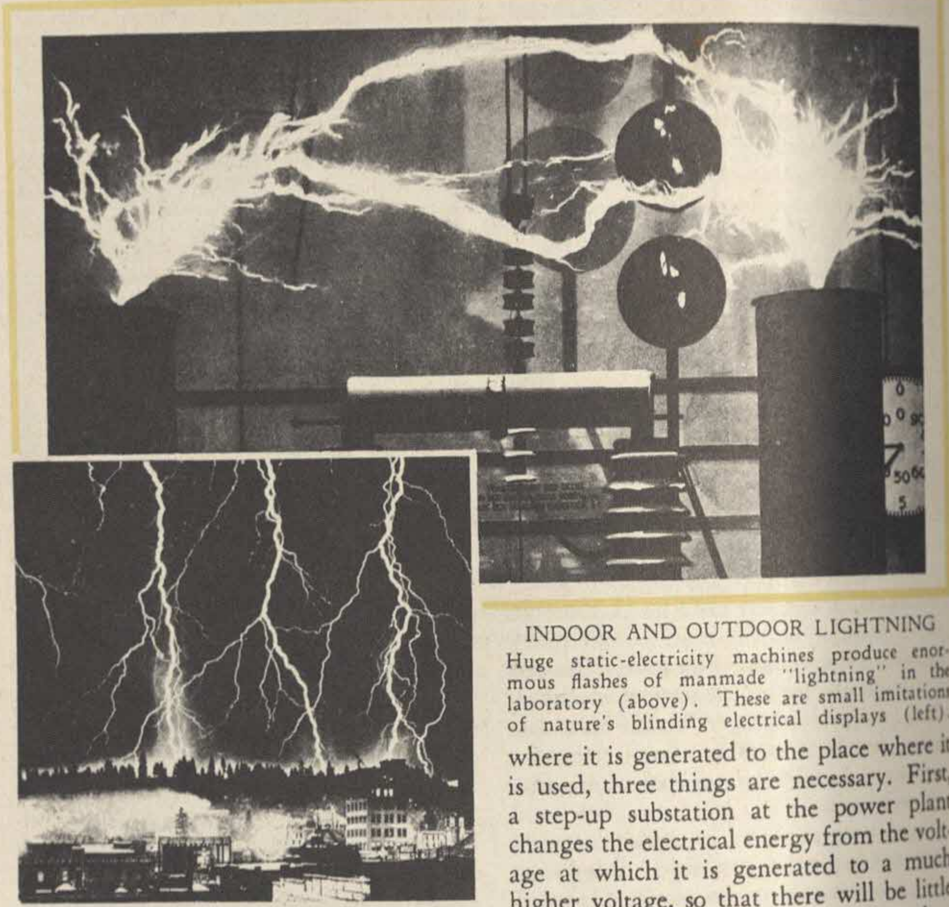
through a conductor. Negatively charged bodies simply have an excess of electrons, while positively charged bodies have less than the normal number. Static electricity is electricity which is in a state of rest in a charged body.

Several experiments in static electricity have already been described. Interesting effects of static electricity may be observed, particularly when the atmosphere is dry. Sheets of paper pressed or rubbed against a varnished table are hard to pick up. Combing the hair often produces sparks of static electricity. Walking downstairs on a carpet may so charge a person's body that he will be shocked if he touches a metal doorknob. The lightning flashes in summer and the grinding, crashing noise on the radio are other well-known examples of static electricity.

How Electric Currents are Generated. In spite of the fact that static electricity was discovered long before electric currents were developed, it is of little value today, except for experimentation. To keep motors and other electrical apparatus operating at a constant rate of speed, a steady, even flow of current is needed.

Science early discovered that every body has a certain electrical pressure, called "potential," with respect to every other body. Two such bodies with different potentials, if connected by a conductor, will tend to become equalized by the flow of electrons from one to the other. The force that causes a flow between bodies of different potentials is the *electromotive force* (e.m.f.). After they have become equalized, the potential of one must be increased again to cause a current to flow to the other. This increase in potential requires that some sort of energy be used, and this energy may be furnished by either a dynamo or a battery.

Electric currents generated by dynamos are of two kinds: *alternating* and *direct.* Alternating currents flow first in one direction, then in the other. Direct currents, on the other hand, maintain a steady flow of electricity in one direction. The current generated by batteries is always direct current. Alternating current can be changed to direct by the use of a device known as a *rectifier*.



INDOOR AND OUTDOOR LIGHTNING

Huge static-electricity machines produce enormous flashes of manmade "lightning" in the laboratory (above). These are small imitations of nature's blinding electrical displays (left).

The greater part of our electrical energy comes from steam-driven dynamos, for water power cannot be harnessed without the expenditure of much time and money. The United States government, however, is encouraging a greater use of hydroelectric power by constructing dams in various parts of the country. Most of the hydroelectric plants and steam plants are owned by cities, states, or public-utility companies. Occasionally steam electric plants are built and operated by industrial companies, and many large buildings generate their own power so that they may always have cheap power of their own. Many farms have their own small electric plants.

Transmitting Electric Power. To transmit electric current from the place where it is generated to the place where it is used, three things are necessary. First, a step-up substation at the power plant changes the electrical energy from the voltage at which it is generated to a much higher voltage, so that there will be little waste in transmission. The current then flows through the power line, a series of poles or towers from which are hung heavy copper wires on insulators. The third part of the transmission system is another substation which steps-down the voltage again at the receiving point, so that it can be distributed at a lower voltage to near-by cities.

Big power stations often generate the electricity at over 10,000 volts and then step it up ten or twenty times for transmission. On arriving at the step-down substation, it is reduced greatly and eventually brought down to 110 volts for ordinary use.

Lightning arresters and automatic circuit breakers are inserted into the line to prevent damage to expensive equipment by lightning and short circuits. Direct current is seldom transmitted over great distances, because the voltage cannot be stepped-up to overcome line losses. In many large cities, current is usually transmitted through underground cables.

The Distribution of Electricity. From the substation, power is carried on poles or under the streets to all parts of the area served. Small transformers, on poles or in manholes, step the current down to 220 volts for power purposes or to 110 volts for lighting.

Because the distribution of power grew as the country expanded, our larger cities were formerly a mass of tangled poles and wires. Larger cities now are insisting that power companies bury their wires, and smaller cities have forced telephone and power companies to use the same poles, thus eliminating much of the former unsightliness.

Distribution of electricity is gradually reaching the farm, and many rural sections are now enjoying all the conveniences formerly available only to their more fortunate city neighbors.

It seems certain that, in the future, electric power will be more available and cheaper than ever before, because of the government's ever-increasing activity in taking advantage of the numerous water-power sources and in constructing such gigantic works as Boulder Dam, the Tennessee Valley project, and the Columbia River projects for the development of this unlimited power.

The Future of Electricity. Though we are now living in an age of astonishing electrical development, the fact remains that we have hardly begun to harness this great force. The use of steam as the chief source of power is already rapidly passing; on every hand we see backbreaking labor, formerly performed by man, being taken over by this great invisible servant. Communication is already completely dependent on electricity, and more and more railroad trains are being driven by electric power.

As to the future inventions that will continue to make the burden of mankind lighter, no one can predict. With the chemist and the electrical engineer working hand in hand, there is no limit to the possibilities, and America, together with the world at large, will continue to advance through electricity.

Consult also the following titles:

Ampère, André Marie
Armature
Cable, Submarine
Cathode Rays
Crookes Tubes
Davy, Sir Humphry
Dynamo
Edison, Thomas A.
Electric Battery
Electric Bell
Electric Clock
Electric Heating
Electric Light
Electric Meter
Electric Motor
Electric Railway
Electro-Chemistry
Electrode
Electrolysis
Electromagnet
Electromagnetic Theory of Light
Electromagnetism
Electromotive Force
Electronics
Electroplating
Electrotyping
Faraday, Michael
Galvanometer
Illumination
Induction, Electric
Induction Coil
Insulator
Kilowatt
Lightning
Lightning Rod
Locomotive
Magnetism
Marconi, Guglielmo
Ohm
Photo-Electric Cell
Radar
Radio
Roentgen Rays
Telegraph
Telegraph, Wireless
Telephone
Thermo-Electricity
Vacuum Cleaner
Volt
Watt
Welding

ELECTRIC LIGHT

ELECTRIC LIGHT. Until late in the nineteenth century, American homes were lighted either by gas or by kerosene lamps. For it was not until about 1870 that scientists first began extensive experiments with the electric light, and the use of electric lights was not widespread until about 1885. People of that time marveled that an electric current could travel through a wire, enter a small, pear-shaped globe, and change darkness into light at the turn of a switch. Yet today no one is amazed at the flood of light that fills our homes, in spite of the fact that our lights are several times brighter and much cheaper to operate than those of 1885.

The Arc Light. Light was first produced by electricity in 1801. It was a discovery by Sir Humphry Davy and con-

Bethlehem Steel Co.; Westinghouse Electric and Mfg Co.

TOWARD A BRIGHTER WORLD

The early light bulb above is the humble ancestor of those used in modern buildings

sisted of two pieces of carbon connected to the poles of a powerful battery. He found that by bringing these two carbons together and then separating them slightly, a blinding flame appeared between their points. But because of the great consumption of current, these so-called arc lights were impractical for street or house lighting. Though one was installed in an English lighthouse in 1858, these lights were not widely used until the invention of the dynamo several years later. Because arc lights are so intensely bright and so hard to regulate, they have never been used for home lighting to any extent. Formerly used for street lighting, they are now used chiefly in moving-picture machines, sun lamps, and electric furnaces where temperatures over 6,000° F. have been produced. See Electric Heating.

The operation of the modern arc lamp is quite simple. If two carbon rods, connected to electrical terminals with a sufficient difference of potential, are brought together for just a moment, enough heat is produced at the point of contact to vaporize a little of the carbon, and a very bright light is produced. The rods are automatically separated by electromagnets as soon as this momentary contact is established, and then the current is conducted from one rod to the other by the carbon vapor. The carbons must be replaced at regular intervals, as eventually they are burned away.

The Incandescent Light. A substance is said to be *incandescent* when it becomes so heated that it gives off light. It is on this principle that the modern electric light operates. A fine wire, called a filament, is sealed within a glass bulb, from which nearly all the air has been pumped. Connecting the filament to the outside contact points are small platinum or nickel-iron alloy wires which expand and contract at the same rate as glass when heated. The air must be pumped out to prevent the oxidizing or "burning out" of the filament. Usually the lamp is filled with an inert gas, such as nitrogen or argon.

Thomas Edison, when working on the early electric lights, tried numerous materials as filaments. Finally, a satisfactory one was made from carbon obtained by heating bamboo fiber. Later filaments were made from the threads of cellulose, which was also carbonized; and a few metals, such as osmium and tantalum, were tried. About 1904, tungsten was adopted for filaments. The first tungsten filaments were brittle, but latter methods provided means by which they could be very finely drawn so that they were even finer than a human hair. The chief advantages of tungsten are the facts that it evaporates slowly, even at high temperatures, has a high melting point, and possesses a high resistance; hence it can be heated to a high temperature and thus be made to produce more efficient light.

Early light bulbs were pear-shaped and, when the air was pumped out, were sealed in a sharp tip at the bottom of the bulb. As this tip was often the cause of breakage, a method was found for sealing the bulb inside the metal base of the lamp. Nitrogen and argon gas were inserted in the bulb to prolong the life of the filament, and the bulbs were frosted to reduce the glare.

Today it is possible to buy electric-light bulbs of every conceivable shape from round to tubular. Colored bulbs, frosted bulbs, tiny bulbs no larger than a pea, and giant bulbs as big as a pumpkin are available. A 60-watt bulb, the ordinary size for household use, is much brighter than the best bulb of early days and uses but one eighth of the current per candle power that the old dim bulbs required. Streets, homes, offices, factories, automobiles, electric signs, and even air beacons use such bulbs.

Luminous Discharge Lamps, developed later, are widely used for advertising and display. The glass tubes of the familiar red "neon" signs contain neon gas at low pressure which gives off light when an electric current passes through it. Different characteristic colors are produced by other gases such as helium, argon, and krypton, or by sodium and mercury vapors. The color of the light is often modified by tubes of colored glass. Operation of this type of light requires high voltage but only a small current.

The yellow light of a sodium-vapor lamp is so much brighter than ordinary street lights that these lamps are often used on highways, especially in danger areas and where fog is frequent. The queer greenish-blue light used extensively in photographic studios and for industrial lighting comes from mercury-vapor arc lamps. If quartz tubes are used instead of glass, the intense ultraviolet radiation produced by the lamp can get out and be used to kill bacteria.

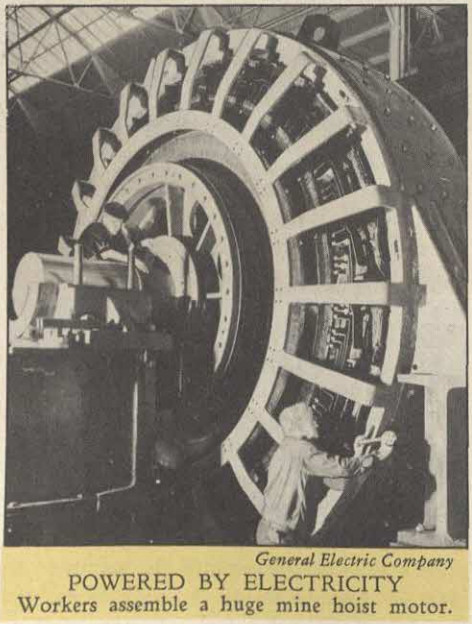
Fluorescent Lamps with long, straight tubes or circular ones, and filled with argon and mercury vapor, are now more extensively used in the United States than are incandescent bulbs. When current passes through the tube, invisible ultraviolet rays are emitted which fall on the fluorescent coating (phosphor) on the inside of the tube and cause it to glow with visible light. The color of this light depends upon the nature of the coating. Millions of lamps are produced yearly in the United States alone. See ELECTRICITY; ILLUMINATION; NEON.

ELECTRIC LOCOMOTIVE. See LOCOMOTIVE.

ELECTRIC METER. In order to have some accurate measure of the amount of electric current a consumer uses, every home, factory, or office building that uses electricity is equipped with an electric meter. This device operates by means of an electric motor running on a small current proportional to the full amount of electrical energy being consumed.

Linked to the motor is a mechanism which operates the hands of several dials registering *kilowatt hours* as the unit of electrical energy. Watts are determined by multiplying the volts by the amperes, and a *watt-hour* is equal to one watt of electrical power per hour. A kilowatt is a thousand watts.

How to Read a Meter. Ordinary electric meters for the home have three dials. The dial at the right represents kilowatts up to 10; the middle dial, kilowatts up to 100; the one on the left, up to 1,000 kilowatts. Where the current consumed is large, extra dials are added which may be read up to 10,000 and 100,000 kilowatts. Suppose we have but three dials; the first, or 1,000's, dial is read first, the center dial next, and so on. The pointer on the dial is always "read back" to the smaller of two numbers between which it stands. Dials are alternately numbered in clockwise and counter-clockwise directions. A good rule to follow in reading a meter is, "Always read the dials from left to right, and select the smaller of the two numbers nearest the pointer on each dial."



General Electric Company

POWERED BY ELECTRICITY

Workers assemble a huge mine hoist motor.

ELECTRIC MOTOR. One of the greatest sources of motive power today is the electric motor. On it depends the operation of dozens of electrical devices such as sweepers, refrigerators, street cars, washers, fans, and a host of other conveniences.

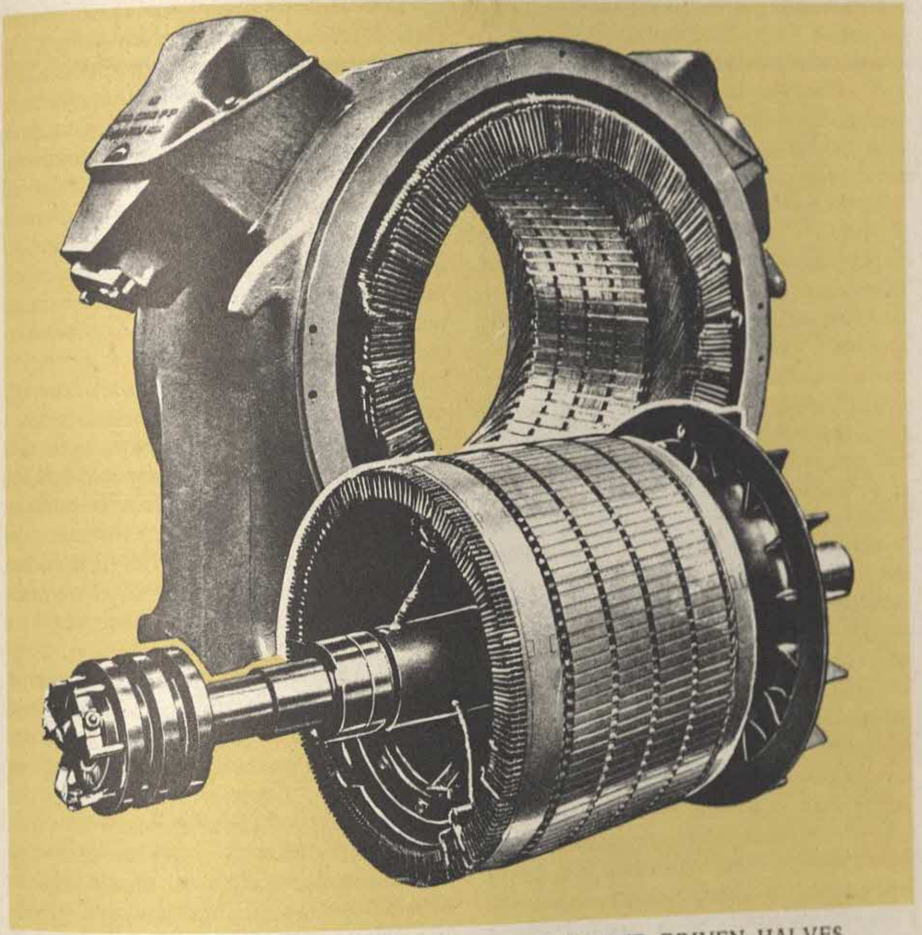
How Motors Operate. There is little difference in construction between a dynamo and an electric motor. Each consists of a magnetic field formed by magnets, an armature with coils, and a set of commutators, or brushes (see DYNAMO). Every coil in the armature, through which current flows, creates about itself a magnetic field. When these coils are brought into the field of a permanent magnet or an electromagnet, such as exists in a motor, the two magnetic fields tend to attract and repel each other (in accordance with the law that like poles attract and unlike repel), thereby causing the armature to revolve.

This effect is brought about by means of the commutator and its attachments, which reverse the current and the polarity so that the armature is kept revolving. The armature of the motor is equipped with a pulley, a belt wheel, or gears, from which power is delivered to other machinery.

Though actually built alike, each motor and dynamo is constructed for the special work it must perform. Dynamos are usually much larger and may furnish energy for a number of motors located at distant points.

ELECTRIC RAILWAY. Until well along in the nineteenth century, city people in America depended for transportation on horse-drawn vehicles or cumbersome cable cars, and an efficient interurban system was wholly unknown. Although experiments with electrical equipment had been carried on for many years, it was not until the dynamo was invented that the electric railway became a practical means of public transportation. Frank J. Sprague designed and, in 1884, demonstrated the first practical electric-railway motor in the United States. He then built so many lines in that country and in Canada that he is called the "father of electric traction in America." Since 1885, thousands of miles of electrified streetcar, elevated, subway, interurban, trolley-bus, and main-line railroad lines have been built.

The Electric-Railway System. The power for electric railways is furnished by



SLAVE AND MASTER—A MOTOR'S DRIVING AND DRIVEN HALVES

The *stator* (above) stands still, while the *rotor*, or *armature*, revolves within it, providing the motor's driving force. Current is introduced to the wire windings of the stator, producing a continuously revolving magnetic field. The corresponding windings on the armature follow this field around, while speed is controlled through slip rings (left).

dynamos in the individual company's own powerhouse, or is purchased from a public-utility company. This power is carried through a *feeder* line, along the side of the railway, and is fed at frequent intervals into the *trolley* wire strung over the tracks. As the car runs along, the current is taken from the trolley wire by a small, grooved wheel called the trolley. A pole attached to this wheel takes the current to the motors, which are directly connected to the trucks of the car. A controller for regulating the speed of the motors is placed in the circuit, and with this controller the motorman regulates the speed of the car. After using the current, the motors send it through the wheels to the rails and thence back to the power station, completing the circuit.

Other electric railways use a *third rail* instead of a trolley. This extra rail is mounted on insulators and extends between the rails or just outside one of them. An iron shoe, attached to one of the trucks, slides over the rail, picks up the current, and carries it to the motors. Such a system is dangerous to both people and animals and cannot be used in safety except where the rail is kept out of reach.

Still another system, used where overhead wires are prohibited, is the *conduit* system. A conductor rail is sunk into a slot, and a metal arm from the car reaches into the crevice, making the electrical contact.

Electrification of Railroads. Because of bus and automobile competition, the electric railway mileage in the United States has dropped drastically as streetcar, elevated, and interurban lines have been abandoned. Many steam railroad companies continue to increase their mileage, however, for electrification not only gives the public better and faster service, but keeps cities free from the smoke of steam locomotives. The Pennsylvania Railroad has electrified its entire line between Washington, D. C., and New York City. All trains going into Manhattan Borough, New York City, are pulled by electric locomotives, as are those operating between the Cleveland central terminal and outlying towns. The suburban lines of the Illinois Central serving Chicago are all electrified.

In Western Montana, Idaho, and Washington, the Chicago, Milwaukee, Saint Paul & Pacific Railroad has electrified more than 600 miles of its transcontinental line, for in portions of that region, electricity is cheaply generated by water power. Such a system has proved economical; on the downhill runs, the motors not only act as air brakes, but are used as generators to develop part of the power necessary in climbing the next slope.

ELECTRIC WELDING. See WELDING.

ELECTRO-CHEMISTRY. Much of the science of electricity is inseparably linked with chemistry. The combined science, known as *electro-chemistry,* deals in general with the relation of electric current to chemical changes. For instance, in electric cells chemical changes bring about the generation of electric currents; in electrolysis, however, chemical changes are brought about by the passage of an electric current.

Electro-chemistry has brought about many new products and processes of manufacture. Both lye and chlorine gas are manufactured by passing currents through a solution of common salt. The purification of copper and zinc, the manufacture of aluminum from bauxite (aluminum ore), electrotyping, and electroplating all owe their origin to the electro-chemist. Electrolysis and electroplating are essential features of modern industry and their possibilities are almost unlimited. See ELECTRIC BATTERY; ELECTROLYSIS; ELECTROPLATING; ELECTROTYPING.

ELEC'TRODE. The terminals through which electric current enters and leaves a body are commonly known as *poles,* or *electrodes.* The positive electrode is called the *anode;* the negative electrode is the *cathode.* Faraday, a pioneer in electricity, was the originator of these terms. Formerly they applied only to the process of electrolysis, today the terms are in general use wherever electricity is used as energy.

ELECTROL'YSIS. When an electric current is passed through any solution and the compounds in that solution are decomposed, the process is known as *electrolysis.* Acids, bases, and salts in solution dissociate into tiny charged particles known as *ions.* These solutions will conduct an electric current and are known as *electrolytes,* whereas substances like sugar and glycerine, which are not ionized in solution, will not conduct an electric current and are known as *non-electrolytes.*

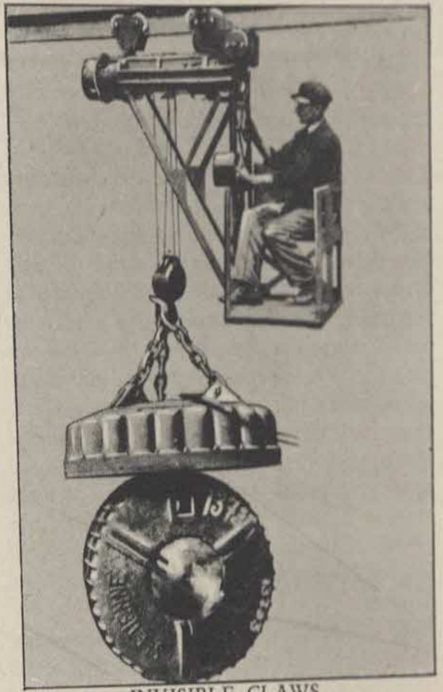
How Electrolytes Work. When two electrodes are inserted in an electrolyte and direct current is applied, the positive ions in the solution begin to move toward the negative plate, or cathode. They receive electrons from the cathode, thereby taking the charge off the ions and forming a new substance. The same sort of action occurs at the positive plate. For instance, if a solution of copper chloride is electrolyzed, the copper ions will move to the negative electrode, where metallic copper will plate out; chlorine gas will form in a similar manner at the positive pole. This actual motion of the ions in solution constitutes the electric current through that solution.

Uses of Electrolysis. Electrolysis has an important place in modern industry. Metallic aluminum can be prepared commercially only by dissolving aluminum ore (bauxite) in melted cryolite and electrolyzing the solution; metallic sodium is prepared in a similar manner. Gold, silver, copper, and other metals are refined by electrolysis; both electroplating and electrotyping are electrolytic operations.

One of the undesirable features of electrolysis is the fact that where electric currents are carried underground, they may cause corrosion and breakage of gas, water, or sewer pipes, where the pipes act as positive electrodes. This difficulty is frequently overcome by providing the current with a better return conductor.

ELECTROMAG'NET. Probably the most important basic development in the field of electricity is the electromagnet, for even the indispensable electric motor makes use of it. A simple electromagnet may easily be made by winding several turns of small insulated wire around a piece of soft iron. When the ends of this coil are attached to a battery, the iron core will pick up small tacks, nails, and bits of iron. The softer the iron core, the greater the size of the coil; and the greater the current applied, the stronger will be the pull of the magnet. Such magnets may be made in a straight form, but often the core is shaped like a horseshoe with coils wound upon the ends, the bend remaining uncovered. Permanent magnets can be formed when steel, instead of soft iron, is used as a core.

How Electromagnets Work. When soft iron is used as a core, magnetism will remain only so long as current flows through the coil. Such cores should be in the form of a bundle of soft iron wires, rather than in a single piece. If steel is used as a core, the windings may be removed, and the steel will retain its magnetism permanently. Electromagnets have two advantages over permanent magnets: the magnetism can be controlled by controlling the flow of current, and the magnets can be made much stronger either by increasing the current or by enlarging the size of the coil.



INVISIBLE CLAWS

Big electromagnets used on cranes which handle metal have tremendous lifting power. The strength lies in a number of iron cylinders wound with wire. Current in the wire magnetizes the cylinders. which will then grab the metal.

Every wire carrying a current creates an electric field containing magnetic "lines of force." When the conductor is wound around a soft iron core, the core is magnetized; and the greater the number of turns of wire in the coil, the greater will be this magnetic force.

Uses of Electromagnets. The most important use to which the electromagnet is put is creating a magnetic field in dynamos. In this sense, then, the electromagnet might be said to be the "father" of all electric power. Electric bells, buzzers, telegraph sounders, and relays, and even telephone receivers and radio loud speakers depend upon the electromagnet, as do most electrical measuring instruments. One of the heaviest duties of the electromagnet is performed in the steel mills, where great masses of iron and steel are picked up and carried from place to place by giant electromagnets suspended on cranes.

ELECTROMAGNETIC THEORY OF LIGHT. The modern theory concerning light is that it is a form of electromagnetic radiation of the same nature as radio waves sent out by oscillating currents of electricity. Such waves consist of vibrations at right angles to the direction in which the waves travel. All waves of this type are classified as electromagnetic radiations. They range from the shortest gamma rays through X-rays, ultraviolet rays, visible light rays, and infrared rays to radio waves. All have the same velocity as light waves. The shortest have the highest rate of vibration, the speed of vibration decreasing as the wave length increases. See Light.

ELEC'TROMAG'NETISM. Early in the nineteenth century, scientists discovered that electricity and magnetism are definitely related to each other. The science that treats of this relation is electromagnetism. It was through a knowledge of this science that the construction of the dynamo and motor was possible.

Let us imagine that we have a copper wire running due north and south, through which a current is flowing. Now, if we place a compass (in which the needle will, of course, also be pointing north and south) below this wire, the compass needle will be deflected to the right or left. If the current flows from south to north, the north end of the needle turns toward the west; if the current flows from north to south, the needle turns toward the east. This is a simple method for determining the direction of an electric current; and upon this theory the galvanometer, an instrument for measuring currents, was built. See Galvanometer.

If a wire that is part of a closed circuit is brought close to a magnet, or if the magnet is moved close to the fixed wire, an electric current flows in the wire during the motion. Thus we see that a current is created in the wire by moving it in the vicinity of the magnet. Similarly, we have seen that a current flowing through a wire sets up a magnetic field (lines of force) around the conductor. Thus the close relationship between electricity and magnetism can be demonstrated, and on these two simple principles much of the great electrical progress of today is based. See Dynamo; Electromagnet.

ELECTROMOTIVE FORCE. The measure of an electric current is its amperage. The voltage, also called electromotive force (e.m.f.), is in the pressure that forces the current along against the conductor's resistance. It might be compared to the pressure behind water as it flows through a pipe. Where water enters a pipe, it will have a certain pressure; farther along the line the pressure will be less because of friction in the pipe. In the same way the voltage of a current will drop off as it proceeds along the wire. In order to build up the pressure again, transformers may be inserted into the transmission line. The difference in voltage between *two points* in a circuit is called the *difference of potential*.

The unit of electromotive force (or electrical pressure) is called a volt, which is defined as the pressure which causes a current of one ampere to flow through a resistance of one ohm. Dry cells usually have a pressure of one and one-half volts, storage batteries six volts, and ordinary house current about 110 volts. Dynamos deliver an electromotive force varying from a few volts to many thousand. A man may withstand several thousand volts without injury if the amperage is low. On the other hand, a few hundred volts combined with a heavy amperage will cause instant death. See Ampere.

ELECTRONICS. When imprisoned in vacuum tubes ranging from very tiny cylinders to those several feet long, electrons—minute, negatively charged units of electricity — are unbelievably powerful. Electronics, as its name implies, is the

ELECTRONICS

ELECTRON

—the natural unit of *negative* electric charge. Its atomic weight (chemical) is 0.000548. Every atom contains one or more electrons.

PROTON

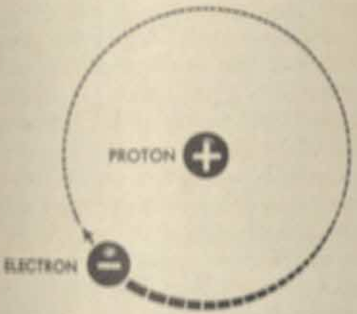
—a particle with unit *positive* electric charge and the atomic weight 1.00731. The charge on an atomic nucleus comes from the protons in it.

NEUTRON

—an uncharged particle of atomic weight 1.00868. Except for the lightest hydrogen nucleus, every atomic nucleus contains one or more neutrons.

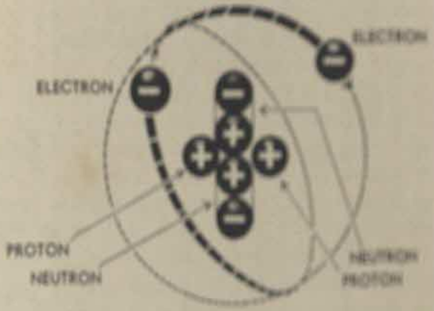
These—in various combinations—make up the atoms of elements.

HYDROGEN ATOM



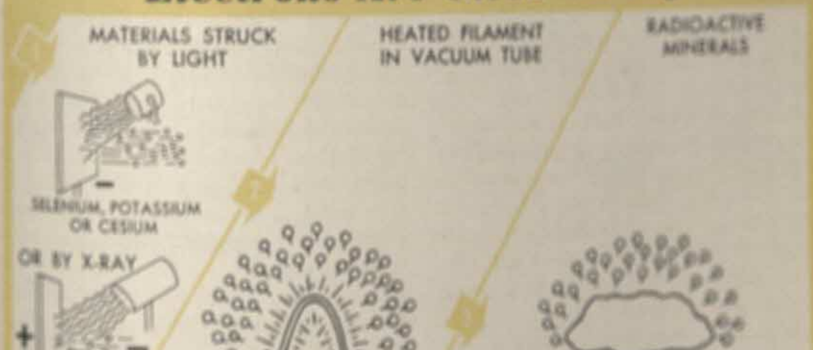
THE SIMPLEST ATOMIC STRUCTURE

HELIUM ATOM

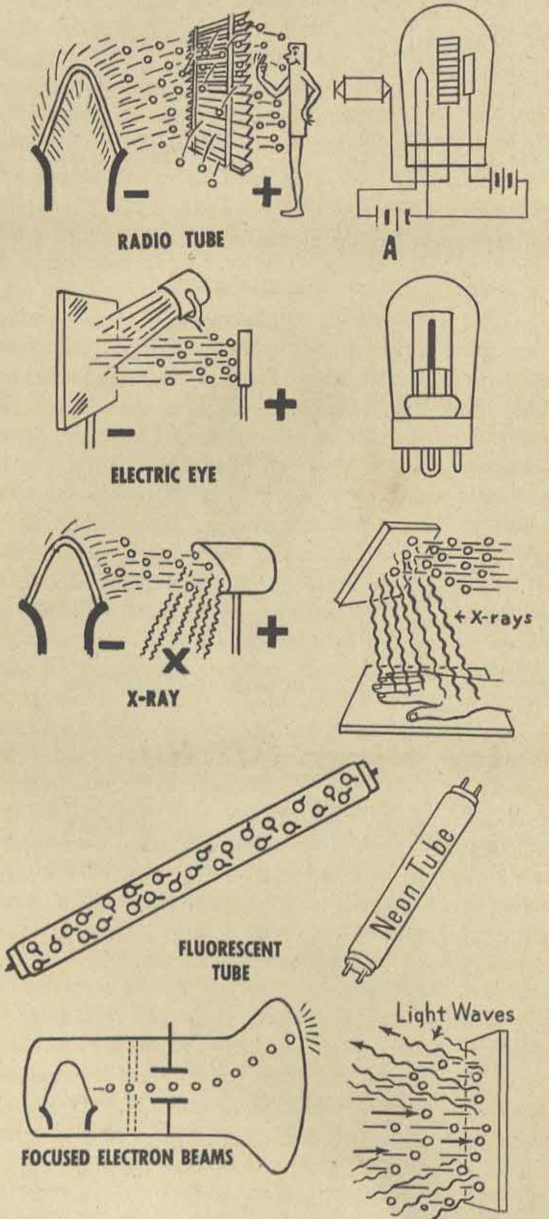


A MORE COMPLEX STRUCTURE

Electrons Are Given Off By:


1
MATERIALS STRUCK BY LIGHT
SELENIUM, POTASSIUM OR CESIUM
OR BY X-RAY
COMMON METAL SUCH AS ZINC
2
HEATED FILAMENT IN VACUUM TUBE
3
RADIOACTIVE MINERALS
PITCHBLENDE
ELECTRONS FROM RADIOACTIVE ELEMENTS ARE CALLED BETA PARTICLES

Controlled Electronics-*Servant of Man*



COURTESY OF ZENITH RADIO CORP., WESTINGHOUSE, GENERAL ELECTRIC X-RAY CORP., PAN-AMERICAN AIRWAYS, U. S. DEPT. OF AGRICULTURE, AND R.C.A. VICTOR.

Applications of electronics shown in photographs are (1) the radio, (2) the electric eye, (3) the X-ray, (4) neon lighting, (5) the electron microscope, and (6) television.

science of the electron and its applications. The needs of World War II so speeded investigation and discovery that in a few short months this science made progress that normally would have required years. See CHEMISTRY; ELECTRICITY.

History. Sir Joseph John Thomson in 1897 discovered that cathode rays consist of negatively charged particles called electrons; and from his experiments and those of other physicists investigating the conduction of electricity through gases, at the turn of the century, the electronic theory of electricity was born.

Thomas A. Edison, in the 1880's, had discovered the principle of the electron tube, without recognizing it as such. J. Ambrose Fleming in England made a similar discovery. But neither could control the electrons and make the tube useful. Then Lee De Forest placed a grid between filament and plate in the tube, electrified the grid, and mastered the electrons. The radio tube was the first large application of this type of electron tube. An important use of electronics is radar, initial patents on which were taken out in 1929. See RADAR.

Electron Tubes. There are many types of electron tubes, each made for a specific purpose, but often combined for special services. All but the photoelectric cell, however, use the same basic principle: A hot filament shoots out electrons, and there is at least one plate, with at least one grid between the plate and the filament. Tubes have been perfected that operate at two million volts.

Electron tubes are faster and more accurate than human eye or hand, calculating and measuring with the speed of lightning. When connected with anything that moves, cuts, beats, or measures, they record on a meter in electrical terms every motion and its effect.

Uses of Electronic Devices. Countless are the applications of the electron tubes, with new uses and devices being discovered daily. In World War II, they were used in guiding airplanes and battleships, hunting submarines, directing gunfire, and sounding ocean depths.

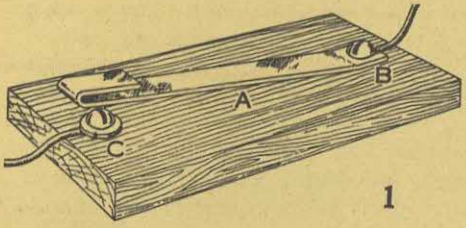
Electronic tubes can be made so supersensitive that they can exactly detect, watch, and control temperatures so as to keep correct and constant heat in manufacturing processes, thus shortening production time and making a better product. The sensitive electric eye, which had closed and opened doors for years, is an electronic device. The electron microscope sees, and makes it possible to photograph, bodies so tiny that they are invisible under the most powerful optical microscope. Television is another application of the science of electronics. See TELEVISION.

Every branch of science has benefited by the use of electronic devices. Power can be diverted from alternating to direct current. Motor speed and voltage are accurately controlled. Metal parts can be fabricated faster than ever before. Electronic welding does its work before the mass of metal is warmed. In making plywood, electronics is of great value in drying the glue between the layers of wood.

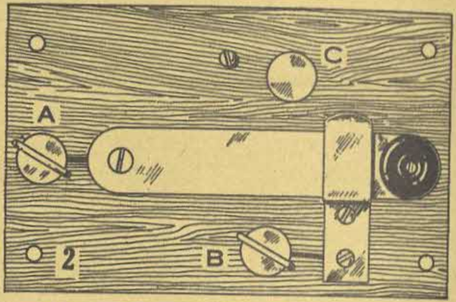
In medicine, X-rays have been greatly perfected, and ultraviolet and bactericidal radiations are of immense value. The electronic machines used medicinally to induce fever have also been adapted to industry, where quick heat changes and assured controls are necessary. Especially valuable is the fact that the heat can be applied either to a large object or to one no larger than a pinhead.

In the home, applications are countless. Electronic sterilamps disinfect refrigerators. Electronic air cleaners keep homes free of dust. Fever-inducing machines become stoves, timing cooking to the minute with automatic controls. Painting can be done electronically. Food can be sorted—dirt and foreign particles being removed as ore in mines is separated from dust, dirt, and rocks—by means of electronics.

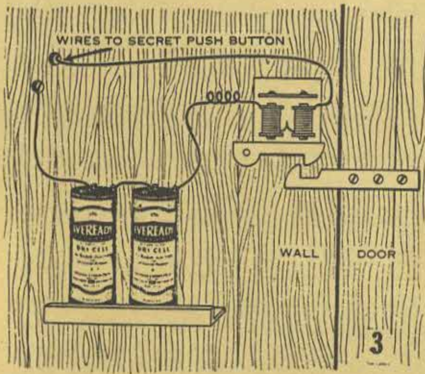
ELECTROPLATING, *e lek′ tro pla ting.* One of the most practical uses of electrolysis in our everyday life is the process of coating a cheaper metal with gold, silver,

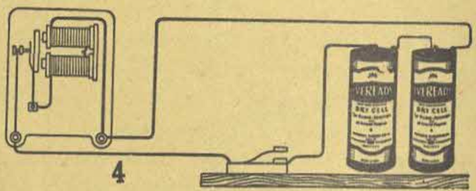


A homemade "push button" (1) will send all kinds of messages. A strip of tin or brass (*A*) is bent to form a spring. Mounted on a piece of wood and connected to one wire (*B*), it completes the circuit when pushed against pole *C*.



Switches to do tricks (2). Connect the swinging brass arm to the current pole *A*, and the slot for the arm to the other post (*B*). Moving the arm breaks the circuit. For a two-line switch, add a third post (*C*).

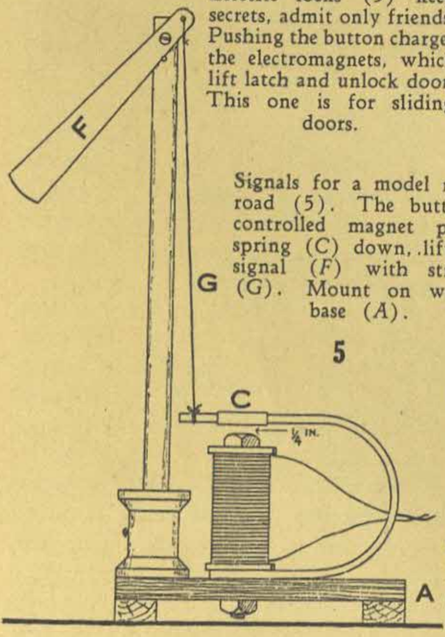




A practice telegraph key (4) works with a buzzer. Connect one wire from the batteries to one pole of the buzzer, and the other through the key back to batteries. A complete set includes two keys and buzzers.

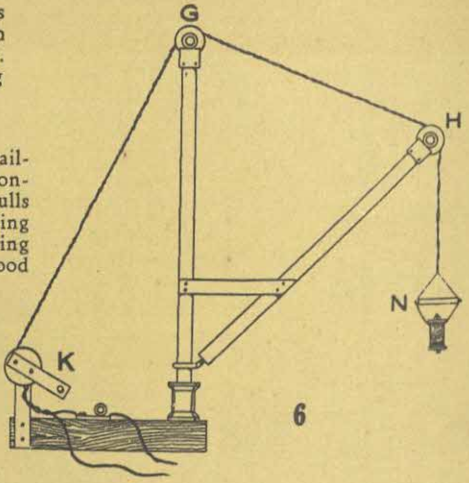
Courtesy National Carbon Co.

Electric locks (3) keep secrets, admit only friends. Pushing the button charges the electromagnets, which lift latch and unlock door. This one is for sliding doors.



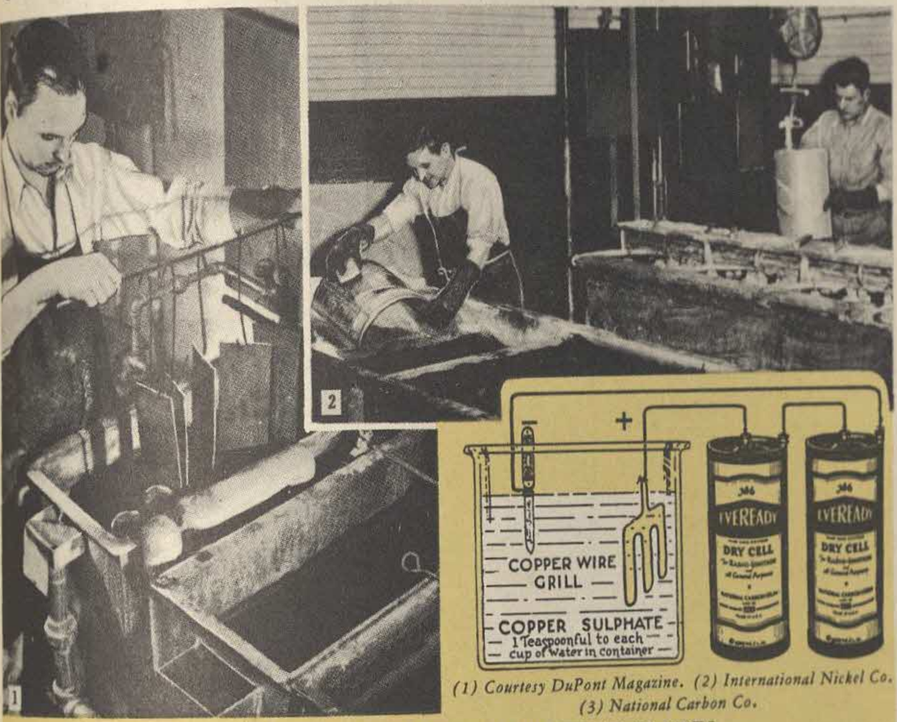
Signals for a model railroad (5). The button-controlled magnet pulls spring (*C*) down, lifting signal (*F*) with string (*G*). Mount on wood base (*A*).

5



An electromagnetic crane (6). You can make the wooden beams of this crane with any sticks. Put little wheels at *G* and *H*, and a crank (*K*) on winding spool. Two wires go over spool and wheels to magnet (*N*), which does the work.

FUN WITH ELECTRICITY



(1) Courtesy DuPont Magazine. (2) International Nickel Co. (3) National Carbon Co.

ELECTRICITY REPRODUCES PRINTING PLATES

Reproducing expensive photo-engravings and type forms in complete unit printing plates which will stand up under high-speed press runs is an important element in the perfection of today's graphic arts. (1) Inspecting partially completed "electro" shells. (2) Cleaning curved electrotypes for newspaper press. (3) Simplified form of electroplating.

nickel, or any other metal. This process, called *electroplating,* is used in the manufacture of silverware, the plating of musical instruments with gold, silver, or nickel, in the manufacture of inexpensive jewelry, and in electrotyping. See ELECTROTYPING.

Let us suppose that we wish to plate a brass trumpet with silver. As an electrolyte, we use a solution of silver cyanide. In this solution we suspend the trumpet, attached to the negative pole of a battery or generator. To the positive pole, we fasten a plate of pure silver. When the current is turned on, the silver from the cyanide solution is carried to the trumpet and gradually deposited as a thin coat of silver. At the same time, the silver plate slowly dissolves and takes the place of the silver that has been used from the solution. The longer the process is continued, the thicker will be the silver plate on the trumpet. By using the above procedure, we can plate an object with many different metals; but, of course, the solution and the positive metal plate will be different in every case. Moreover, the conditions of the electroplating must be carefully controlled for best results.

ELECTROTYPING. To the publisher or printer, no electrical process is of more importance than that of electrotyping. In order to cut typesetting, engraving, and printing costs, electrotypes, or duplicates of the original type or engraving, are made of copper, nickel, or chrome. They have the advantage of hardness and will continue to print clearly long after ordinary type metal would have been worn down. Millions of impressions have been made from a single electrotype. Electrotypes are used chiefly in the printing of books and magazines and in the making of fine engravings and halftones.

How Electrotypes Are Made. After type is set and is locked up in a form, it is dusted with a thin layer of powdered graphite. A sheet of beeswax is then laid over the type, and pressure is applied until the impression of the type is made on the wax. The wax mold is then powdered with graphite so that it will conduct electricity. It is next washed with a weak solution of copper sulphate and dusted with iron filings.

A solution of sulphuric acid and copper sulphate is prepared, and the wax mold is attached to the negative pole of a battery or generator and immersed in the solution. As in other forms of electroplating, a sheet of the plating metal is hung in front of the positive pole. In this case, the sheet will be copper. Current is then applied, and the copper from the solution collects on the wax mold. It is immediately replaced in the solution by more copper dissolved from the plate. After copper has formed on the wax mold for several hours, the process is halted, and the shell, or copper "type," is removed from the wax. It is backed up with a layer of type metal or lead and is trimmed and finished to a standard thickness. The process may be varied by making electrotypes of nickel or by chromium plating the copper plates. See ELECTROLYSIS; HALFTONE; PRINTING.

ELEGY, *el'e je.* Poems inspired by death, or those whose subject matter is death, are usually called elegies. They are nearly always laments for a person who has died. Such a poem is Shelley's *Adonais,* written after the death of his friend Keats. But the mere thought of death often stirs poets to write elegies. Such a work is the famous *Elegy Written in a Country Churchyard* by Thomas Gray. Thus the word *elegy* has come to mean rather broadly a meditation on serious or sad things. It is extended, with a similar meaning, into the field of music.

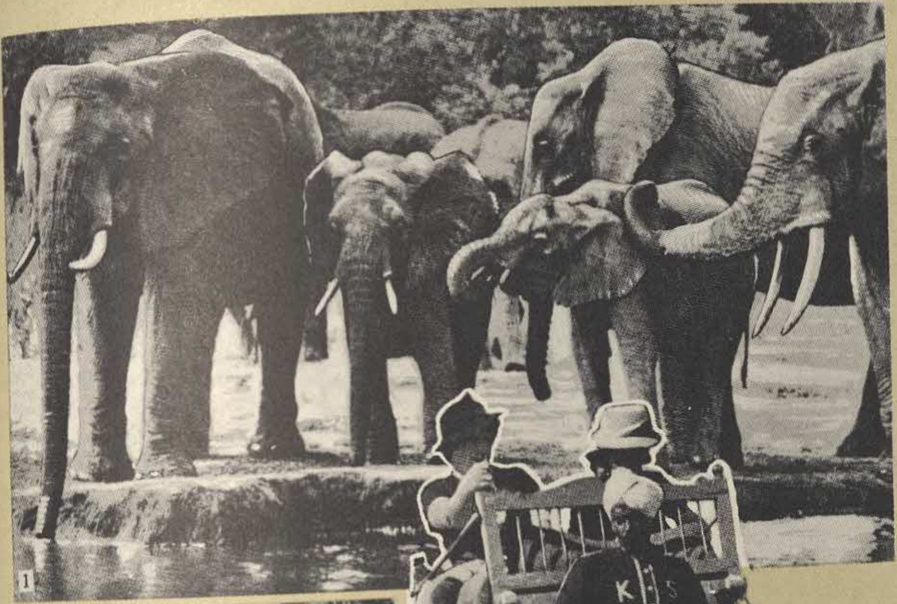
ELEMENTS. See CHEMISTRY.

ELEPHANT, *el' e fant.* If one considers all the ancestors of the elephant, he would be surprised to learn that sixty million years ago there were more than 300 species of this great animal. Today there are but two species—one a native of India, the other an inhabitant of the jungles of Africa. The Indian elephant is easier to tame but is not so large or so strong as its African cousin. It differs also in having smaller ears, a higher head, and a straight back; and only the males bear tusks. The African elephant has large, floppy ears, a lower head, a tougher hide, and a back which slopes to the tail. Both the male and the female have tusks, which usually are removed in captivity. The Indian elephant is the most common in circuses and zoos, although there are a number of African elephants also to be seen under tents and roofs.

Since it is the largest of all land animals and possesses excellent means of defense, the elephant has little to fear from other beasts. It eats grass and other vegetation, picking up its food with its trunk, which is really an extension of its nose and upper lip. The trunk also carries food and water to its mouth. The tip of the trunk is very sensitive, and the Indian elephant is able to pick up such small articles as peanuts, with the aid of two finger-like projections inside the tip of the trunk. The legs of an elephant are so large and strong that they resemble tree trunks. The toes are covered with hard nails. Elephants range in weight from 4,000 to 14,000 pounds, and often the tusks, which are extensions of the cutting teeth, weigh 200 pounds or more each.

Elephants travel in herds and apparently have a leader which guides the others to watering and grazing places. They are captured by digging huge pits into which one of the beasts may fall, or by driving a herd into a large, strong corral. Sometimes tame elephants are sent into a herd to make friends with wild elephants and lead them into captivity.

In India, native elephant keepers take excellent care of the beasts, bathing them often and caring for their skin so that ticks will not enter cracks in the thick hide. Although the usual color of elephants is a dark gray, buff-colored, or "white," ele-



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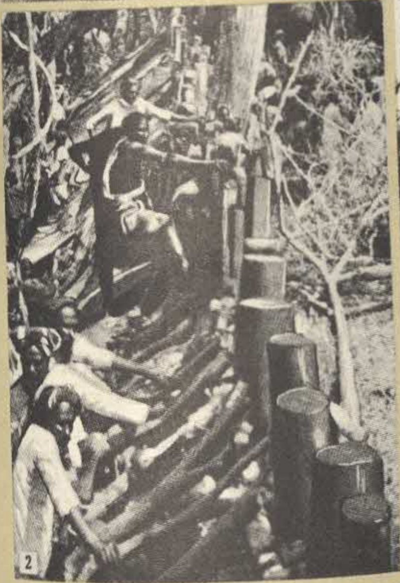

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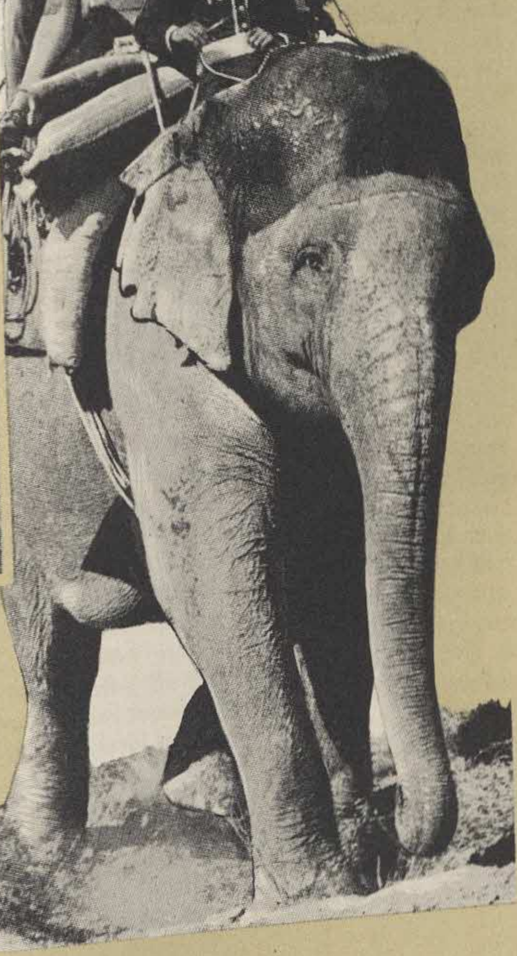


3

AMIABLE GIANTS

The elephant, largest of land animals, is found in India and Africa as two different species. The most obvious difference is the size of the ears, which is much greater in the African elephant (1). The huge beasts roam the jungles in herds, feeding on plants and leaves. In India, wild elephants are herded into a huge stockade under the guidance of tame animals (2). They are then trained to do such work as logging, and soon become tractable enough for use in hunting and sports (3).

phants are found occasionally. In Ceylon and Sumatra they are venerated.

How Elephants Serve Man. Many tales have been told of how elephants use their great strength to lift heavy logs or to push trucks and wagons. Still other stories point out how these intelligent beasts are trained to do tricks and to use their strength to aid man in his work and in war. In India, for example, the elephant is commonly used to move and pile heavy logs, for transportation, and for tiger hunting. In the wars between ancient Carthage and Rome, Hannibal's armored elephants were formidable weapons in battle. The circus elephants have delighted children for generations in many countries. Their amazing balancing tricks and lumbering dances are circus highlights, but the elephants also do their share in loading and unloading the circus equipment. Elephants also are valuable commercially, for their tusks are the source of ivory. The quest of the white man for this valuable substance, from which piano keys, ornaments, and implements are made, was responsible for much of the exploration and colonization of Africa. Plastics have replaced ivory in most uses. See PLASTICS.

Elephant Superstitions. Among the popular beliefs about elephants are that they never forget abuses and that they are afraid of mice. Neither is true. Other stories tell how the great beasts wander away to an elephant graveyard when they are about to die. But no such burial places have ever been found by explorers, who have sought them for many years.

ELEPHANT SEAL. The largest of the seals, appropriately named the elephant seal, is a huge, awkward creature which may grow to a length of over twenty feet and weigh tons. There are two species, one found in the waters of the Southern Hemisphere and the other around the Mexican island of Guadalupe in the Pacific, where a refuge for the ungainly creatures is maintained. The seals have flexible snouts, or trunks, which in the male may reach a length of sixteen inches. They spend their days sleeping on sandy beaches and enter the sea at night to search for food. They shed their skin and hair with the changing seasons. Before the Mexican government placed the northern elephant seal under its protection, it was hunted for its oil.

ELEVATED RAILWAY. The rattling and clanging elevated railways that run on a framework above the level of the street have served such American cities as New York, Chicago, Boston, and Philadelphia. The railroads also served the suburbs of these cities and in some cases connected with subway lines. The elevated railway, sometimes called the "L," runs above the heavy traffic of the streets and is cheaper to build than a subway. On the other hand, elevated structures crowd and darken city streets, and some have been torn down.

Upon a framework of steel, supported by steel pillars, ties are laid, to which rails are spiked. Stations are built above the level of the track and are reached from the street level by stairways or elevators. The first elevated railway was built in New York in 1867. At first steam power was used, but steam has been replaced everywhere by electricity. The monorail is a type of elevated railway in which the cars are suspended beneath the girders. This type is used chiefly in German cities.

EL'EVATOR. Great cities, with their cloud-reaching skylines, would be far different were it not for the high-speed elevators which whisk us from the ground up to forty, fifty, and even more stories in not much more than a minute. As a matter of fact, without elevators there would be no towering office buildings, for it is the elevators which make high structures possible. If office buildings and department stores had to be built at a lower height, business districts would occupy a larger area and possibly be less convenient. And such buildings, located on valuable land, would return less income to their owners, for the number of renters would be decreased.

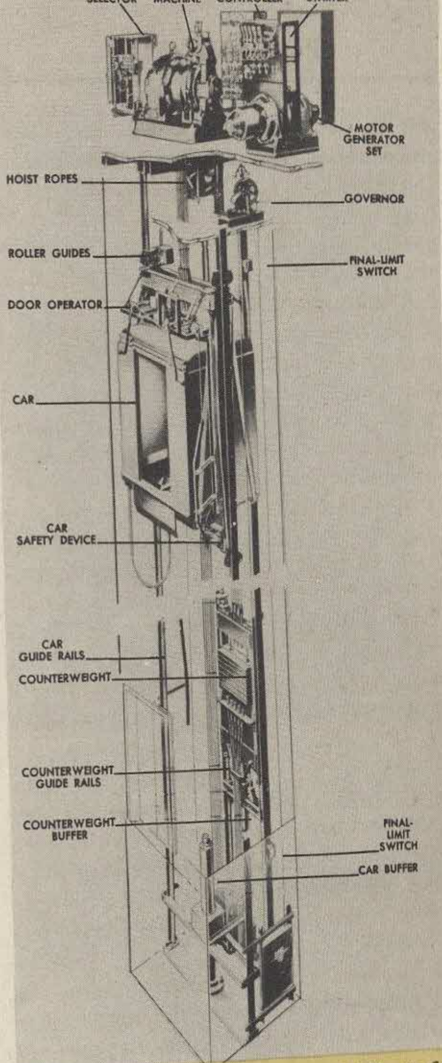
How Elevators Work. Nearly all passenger elevators installed in modern buildings are run by electricity. All modern elevators are protected by safety devices and are inspected periodically by city officials to insure proper working. The type of elevator in common use is the gearless traction, which has cables running directly from the top of the cab to the pulleys of the electric motor at the top of the shaft. These cables wind around the pulleys to another sheave and are attached to counterweights which run vertically on tracks at the back of the shaft.

The entire operation is governed from the car either by a lever which starts and stops the car or by buttons which control it automatically. During recent years, the micro-drive control has been developed, permitting the car to stop at a floor on a level without any manipulation by the attendant, thus saving time and preventing wear on the machinery. Light signals on the floors indicate the approach of the elevator two floors before the car reaches the level.

With automatic-signal control, the attendant in the elevator needs to do nothing but push buttons. Passengers call their floors when they step into the car, and the attendant pushes the button for that floor. When the car starts, it speeds upwards, stops at the floor designated, and the doors open automatically. When the attendant is ready to start again, the doors close, and the elevator continues its journey smoothly and quietly.

In many apartment houses and hotels, there are no attendants, and the passengers themselves press the buttons to start the elevator and stop it at the floors desired. These elevators are usually slower than those in office buildings and department stores.

Some of the safety devices with which modern elevators are equipped include brakes and guards to prevent falling should the cables break, a switch to cut off the current and apply the brakes when the speed becomes too great, buffers at the bottom of the shaft to bring the car to a gradual stop should it fall, and locks and gates on the cars which prevent injury.

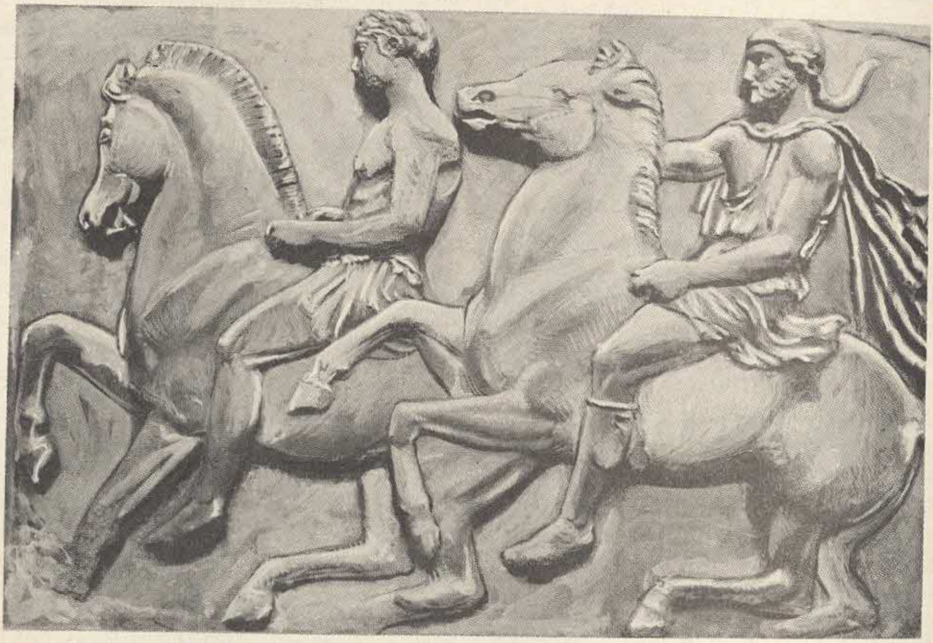


Otis Elevator Co.

VERTICAL TRANSPORTATION

Without elevators, there would be no skyscrapers. The modern, gearless elevator is a miracle of automatic operation.

From Steam to Spark. The first elevator was a steam-driven platform hoist invented in 1850 by Henry Waterman of New York City. Two years later, Elisha Graves Otis began the manufacture of elevators, and in 1857 the first passenger elevator, a steam-driven affair, was constructed. The first office-building elevator was installed in 1859. During the next decade, steam engines were replaced by hydraulic elevators in many buildings. These were faster than the old type, attaining a speed of 600 feet a minute. They worked through the pres-



BRITAIN'S PROUD POSSESSION—THE FINEST GRECIAN BAS-RELIEF

Taken from the frieze which adorned the Parthenon, this beautiful bit of sculpture is now among the Elgin Marbles in the British Museum. The masterpieces were sold by Lord Elgin in 1819, after he had rescued them from the ancient building and brought them to England.

sure of a column of water in a long shaft, and were regulated by ropes or a lever in the car. Some old buildings still have these elevators.

The first electric elevator came into use in 1889. It was operated by ropes which were connected to the motor. These were hoisting cables wound around a drum which was set in motion by a worm-and-gear attachment to the motor. Later, the lever replaced the ropes, the magnet control switch came into being, and the gearless traction system replaced the bulky drum.

Improvements permitted elevators to become faster and faster, until, in 1924, the automatic-signal control permitted speeds of 900 to 1,000 feet per minute. Elevators operate successfully in such buildings as the 102-story Empire State, in New York City, and the Eiffel Tower in Paris, where the elevator rises 526 feet.

EL'GIN MARBLES. One of the rare treasures which may be seen by visitors to the British Museum is in the Elgin Room. For there are preserved the famous Elgin Marbles, the world's finest collection of ancient Greek sculpture. They are named after the seventh Earl of Elgin, who gathered the collection from the ruins of the Acropolis at Athens. Most of the pieces came from the great Parthenon, and the collection includes the principal figures from the pediment of that temple, fifty-six plaques from the frieze which ran around the eaves of the building, and fifteen of the small blocks which formed carved metopes over the columns. These marbles include a Caryatid, or column in the form of a woman's figure, from the Erechtheum; they also include several fragments and some inscriptions.

The Earl of Elgin secured these treasures in 1801 while he was ambassador to Turkey, and with his own money paid to have the collection shipped to England. The British government later bought the marbles for $175,000—less than it cost Lord Elgin to ship them home from Greece. There are some good reproductions available.

ELI'JAH. When the wicked kings Ahab and Ahaziah flourished in the Holy Land, the prophet Elijah arose in their country and denounced them. He told them that if they refused to mend their ways they would be defeated by their enemies. His preaching was disregarded and the prophecy came true. The story of Elijah is begun in the seventeenth chapter of *I Kings* and concluded in the second chapter of *II Kings,* and it reveals that Elijah was perhaps the greatest of Israel's prophets. According to the story, Elijah was carried into Heaven in a chariot of fire. Elisha, the man who saw this ascension, became Elijah's successor on earth. See ELISHA.

ELIOT, GEORGE (1819-1880). Under the pen name of George Eliot, Mary Ann Evans became one of the world's famous novelists, and one of England's two greatest women writers of fiction. Jane Austen alone ranks with her. She was born at Arbury Farm, England, the daughter of a land agent. At the age of seventeen, she was forced to leave school and take charge of the home because of the death of her mother. However, she continued her study of music, philosophy, classical languages, and German, and by the age of twenty-one she had gained an excellent education.

Her vigorous mind turned to creative work. In 1846 was published her translation of Strauss's *Life of Christ,* a work that was warmly received by critics. After a trip abroad, Miss Evans became assistant editor of the London *Westminster Review,* in 1851. Through this position she met many prominent literary people—among them, George Henry Lewes. His sympathetic understanding and encouragement meant everything to her and they became lifelong friends.

Her first novel, *The Sad Fortunes of the Reverend Amos Barton,* was published in 1858. Admiring readers wondered who George Eliot was, for the story appeared under her pen name. With other stories of rural life, it was issued later in a single vol-

THE GOD OF ISRAEL ANSWERS ELIJAH'S CALL

The sacrifice of Elijah was consumed by fire from above. That of the heathens was unburnt.

GEORGE ELIOT
Under a man's name she made her reputation

came under the title *Scenes of Clerical Life.* George Eliot's reputation as a novelist was confirmed when *Adam Bede* appeared. She then wrote *The Mill on the Floss* and *Silas Marner,* pictures of English country life which she knew so well. In a different mood she completed *Romola,* a historical novel whose scene was laid in Italy. Her remaining novels, *Felix Holt, Middlemarch,* and *Daniel Deronda,* are stories of England.

George Lewes died in 1878, and George Eliot wrote no more. In 1880 she married John Walter Cross, a friend of Lewes. She lived only six months after her marriage.

ELISHA. Few of the miracles described in the Old Testament were more spectacular than those performed by the Prophet Elisha (*II Kings,* II, V; XIII, 21). He is said to have made several predictions about the fate of Israel, which came true, and to have performed several miraculous cures. In one case it is related that a dead man came back to life because of Elisha's ministrations. This prophet was the successor of Elijah and, according to the Bible account, he was the only man who saw Elijah taken into Heaven in the fiery chariot.

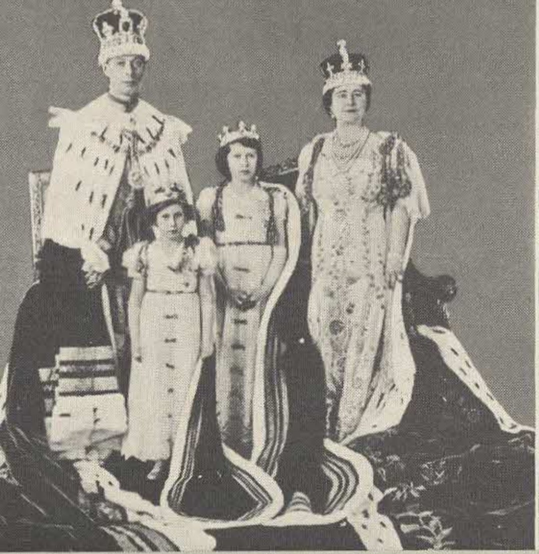
ELIZABETH (1533-1603). England enjoyed one of her most fruitful and prosperous eras under Queen Elizabeth, the last of the Tudor monarchs. During her reign English ships and seafarers, led by Sir Francis Drake, enriched the coffers of the kingdom with their plunder, explored the seven seas, and crushed the naval power of Spain. William Shakespeare, Francis Bacon, Ben Jonson, and Edmund Spenser brought luster to English literature. Life was happier and more prosperous, and Englishmen remember the brilliant years of "Good Queen Bess" as an epoch when the land was truly "Merrie England."

Elizabeth was the daughter of Henry VIII and Anne Boleyn. In her father's will she was placed third in the succession to the throne, after Edward, son of Henry and Jane Seymour, and Mary, daughter of Henry and Catherine of Aragon, his first wife. Following Henry's death, Edward became king, but lived only six years. In 1553 Mary ascended to the throne and immediately imprisoned Elizabeth in the Tower of London, but she feared to execute her half sister because of her popularity with the people. Then, in 1558, Mary died and Elizabeth began the long reign that was to be so prosperous for her people.

She settled the religious question by restoring the Reformed Church, but at the same time was tolerant of the Catholic religion. Because the succession to the throne was so confused, Parliament asked her to marry, but Elizabeth refused. She strove to keep her country at peace, and except for some slight aid to the Huguenots of France and the Protestants in the Netherlands, she was successful until the great naval battle with the Spanish Armada. The claim of Mary, Queen of Scots, to the throne proved troublesome for years, but finally Elizabeth ended it by agreeing to Mary's execution (1587), even though she was against such action.

The greatest event of Elizabeth's reign was the defeat of the Spanish Armada which Philip II of Spain had sent to invade England. This battle occurred in 1588.

ELIZABETH II



Acme Photo; British Information Services

Elizabeth II became Britain's queen upon the death of her father, King George VI, in 1952. She was then twenty-five years old. When she was a child, she did not know that she would one day be queen, for her uncle, and not her father, was the first son of King George V. Her uncle became king as Edward VIII when his father died in 1936, but before the end of that year he had abdicated, and Elizabeth's father came to the throne. At the coronation, with her parents and her sister, Margaret Rose, Elizabeth appeared as royal princess and heiress to the crown (top left).

From that time on, Elizabeth received careful training from her grandmother, Queen Mary, and from other members of the royal household. During World War II she worked for the Allied cause like the rest of her father's subjects, and after the war she made more and more public appearances on state occasions. In 1947 her marriage to Philip, former Prince of Greece, received worldwide publicity.

In 1948 Elizabeth became the mother of a son—Prince Charles—now heir to the throne. Her second child was a daughter—Princess Anne. The third child, and second son Prince Andrew, was born in 1960. This royal family has won the affection of millions all over the world (top right).

Elizabeth and Philip became ambassadors of goodwill for the British Crown. They toured Canada and visited the Union of South Africa. It was during their African tour that they received the tragic news of the death of the King. Returning to England, Elizabeth immediately took on the heavy responsibilities of the reigning British monarch.

ENGLAND'S "QUEEN BESS"

Queen Elizabeth, last of the Tudor line of monarchs, was one of England's greatest rulers. The country enjoyed rapid expansion and prosperity during her reign. Above, a famous portrait of Elizabeth's striking face. Right, the death of the aged queen, in the year 1603.

when the small English ships darted in and out among the clumsy Spanish galleons, sinking one after another, until, shattered by storm, the fleet returned home with but a third of its ships. This triumph eliminated the last obstacle to England's conquest of the sea (see ARMADA).

Much of Elizabeth's success as a ruler was due to the wise ministers she appointed. Burleigh, Bacon, and Walsingham were among the most capable statesmen in Europe, and Elizabeth, acting on their advice, made England respected throughout the world. She was criticized in some quarters for shutting her eyes to the buccaneering of her sailors, but, since they brought riches to the land and the practice was universal, there was no general condemnation of her policies.

In addition to the many other achievements of her reign, to Elizabeth must go the honor of laying the foundations of the future British Empire. It was she who granted the charter to the East India Company, which, through exploration and daring, was to acquire many of the rich lands that are now a part of the greatest empire in the world. In the era of Elizabeth, England developed from a medieval to a modern nation. Her reign was truly her country's "Golden Age."

ELK. The largest and noblest in appearance of any members of the deer family that occur in North America is the wapiti, or American elk. The male, or bull, elk stands over five feet in height and may weigh over 800 pounds. Like other deer, the male grows velvet-covered horns each year. These increase in size and number of branches with succeeding years, though the number of branches does not necessarily correspond with the age of the animal, as is often believed.

By early fall the velvet has been rubbed off against trees, and the horns are sharp and hard, ready for effective use as weapons in the terrific fights which occur among the

PRINCE OF THE ROCKIES

The American wapiti, or elk, a giant deer, was once very common, but is now rarely seen.

adult bulls for the supremacy of the herd of cows and calves. Before spring arrives, the horns have dropped off, and soon a new pair begins to grow. The white-spotted fawns, numbering from one to three, are born usually in May or, sometimes, in early June.

These splendid game animals once roamed from coast to coast in Northern United States, extending far into Canada and southward in the mountainous regions to the Mexican border. They originally ranged over meadow, plain, and woodland, from sea level to points above timber line in the mountains. With advancing settlement they have been driven into mountain pastures of Western United States and Canada.

ELKS, Benevolent and Protective Order of. Founded in 1868 on the principles of benevolence and helpfulness, this fraternal order now has more than 1,500 lodges in the principal cities of the United States and its possessions. Its help and interests are not limited to members and their families, but reach many outside worthy causes, such as charity and aid to sufferers from major disasters. Originally organized in New York, the Grand Lodge was incorporated in 1871 in that city with the past officers of the New York Lodge, Number 1, as charter members. Provision was made for subordinate groups. That same year it extended aid to the victims of the great Chicago fire.

Only white male citizens over twenty-one years of age are eligible for membership. Cities with less than a million population are restricted to one lodge, while larger cities are permitted a lodge for each additional million. A memorial service for members who have died during the year is held in each lodge on the first Sunday in December. At Bedford, Va., is maintained a home for needy members.

ELLIPSE'. What is generally called an oval is known in geometry as an ellipse. It is a shape produced by slicing across a cone at an angle. (A circle, of course, would result if the cone were cut horizontally.) Though this appears to be an odd form, it is really very important. All of the planets in the solar system, including the earth, follow elliptical orbits around the sun. The moon, too, completes an ellipse in traveling around the earth.

Mathematically, an ellipse may be defined as the path of a point moving around two *foci* (each a *focus*), in which the sum of the moving point's distances from the foci is constant. The area of an ellipse is found by the formula πab, with a as half the length, and b as half the width, and π about 3.14159.

EL'LIS ISLAND. Called the "Gateway to the New World," Ellis Island is the government receiving station for immigrants arriving at New York. The island is a mile southwest of the city, in the harbor. All immigrants to the country are here taken off the ships and given thorough physical and mental examinations, as well as tests to determine their fitness to support themselves in America. Those who pass these examinations are sent across the harbor to New York, whence they continue to their destinations. If they do not meet the requirements, they are sent back to their homelands.

Before World War I, millions of immigrants passed through Ellis Island station

THE GLORY OF AMERICA'S FORESTS AND CITIES

Few trees have the majestic symmetry of the American elm. This one is over 150 years old.

Quotas are now limited so that only about 150,000 foreigners may enter the United States each year.

ELLSWORTH, Lincoln (1880-1951). The fascination of the vast, unknown wastes at the opposite ends of the earth lured Lincoln Ellsworth from a comfortable job as a civil engineer to the grueling tasks of Arctic exploration—and to international fame as a discoverer. The son of a wealthy American industrialist, he used his inheritance to further discovery at the Poles. He was with Amundsen in his Polar flights in 1925 and 1926, going nearly to the North Pole in 1925 and crossing it in the dirigible *Norge* in 1926. He went to the Antarctic three times.

The celebrated explorer was born in Chicago and studied civil engineering at Columbia University. His works included *First Crossing of the Polar Sea.*

ELM. Of all the trees the elm is one of the loveliest. Tall and stately, it towers skyward sometimes to a height of 125 feet. Its graceful, slender branches spread out to give welcome shade from the sun.

The elm grows naturally throughout much of North America and Europe and parts of Asia. East of the Rocky Mountains it is found everywhere from Newfoundland to Florida. It thrives especially well in the New England States, where it is commonly found along the roadsides. And in Boston Common alone more than a thousand of these beautiful trees are to be seen. It was under an elm tree that Washington took command of the colonial army in 1775; and that tree, located in Cambridge, became famous as the Washington Elm.

The leaves of the elm are almost oval, but pointed at one end and notched on the edges. The greenish flowers are in small clusters and bloom either before the leaves or with them. The best-known species of elm is the *American,* or *white* elm, which grows in a fan shape. The *slippery,* or *red,* elm is more like a cylinder in shape; and the *cork,* or *rock,* elm, is distinguished by the corklike ridges on the twigs. The *English* elm.sometimes has these corky ridges, but not usually.

More than just ornamental shade trees, the elms are among the most valuable timber trees. The reddish-brown wood is hard and durable and is particularly useful in shipbuilding and in making floors, barrels, and hubs. The inner bark of the slippery elm yields a sticky substance used in medicines.

EL'MAN, MISCHA (1891-). A master of technique and interpretation, Mischa Elman ranks among the greatest violinists of the twentieth century. He is one of the group of Russian-Jewish musicians of his generation which has produced the finest violinists of all time.

Elman was born in the small town of Talnoje, in Russia, and received his first musical training in Odessa. From there he went to the great conservatory at Saint Petersburg, where he studied under Leopold Auer—a celebrated instructor who has trained many of the world's best violinists. Elman began his concert career in 1904 and was enthusiastically received. A few years later he journeyed to the United States and made his first appearance in New York with the Russian Symphony Orchestra.

EMANCIPA'TION PROCLAMA'TION. In 1862, when the tide of battle was against the Union forces in the Civil War, President Lincoln was urged bv many Northerners to discontinue the struggle against the South or else come out flatly for the abolition of slavery. When the war began, Lincoln had no intention of freeing the slaves in the states where slavery already existed. After Lee had been checked at Antietam, however, Lincoln issued the Emancipation Proclamation on September 2, 1862. It stated that slaves in the rebellious states would, on January 1, be freed unless those states had by that time returned to the Union.

The Proclamation went into effect January 1, 1863. Naturally, the South refused to recognize it. Although it did not abolish slavery legally, it paved the way for the Thirteenth Amendment to the Constitution; and this did abolish slavery. See CIVIL WAR IN AMERICA; LINCOLN, ABRAHAM; CONSTITUTION OF THE UNITED STATES, *Thirteenth Amendment.*

EMBAR'GO. In time of war, or when war threatens, a nation concerned may issue a proclamation directed against foreign commerce. This proclamation is an embargo and is made for military and economic reasons usually set forth by the responsible authorities. It may prohibit all domestic vessels from sailing to foreign countries, or may direct that they do not carry certain commodities (which are needed at home or must be kept out of foreign lands); on the other hand, its aim may be to prevent foreign vessels from entering domestic ports.

An embargo may also extend to the seizure of foreign vessels which may be in any local port; such an act is almost certainly preliminary to a declaration of war. Embargoes are not necessarily unfriendly acts; frequently the reverse is true, as when certain goods ostensibly shipped in good faith are really intended for destinations forbid-

FREEDOM FOR AMERICA'S NEGRO MILLIONS
During the American Civil War, Abraham Lincoln, heartened by victory at Antietam, determined to abolish slavery. His Emancipation Proclamation was signed in 1863.

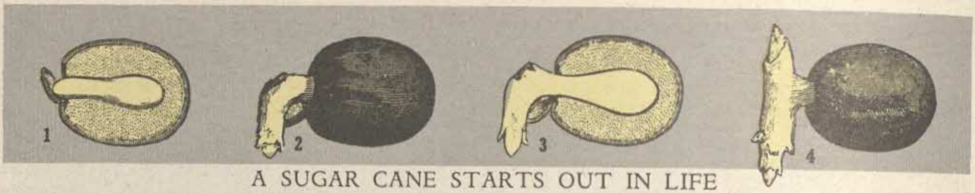
den by general proclamations of neutrality.

Embargo Act. This was a proclamation issued by President Thomas Jefferson in 1807, by authority of Congress, closing the New England ports to all foreign commerce, and forbidding American vessels to clear for foreign ports. It was considered necessary to avoid entangling the United States in the Napoleonic Wars then raging in Europe. The act aroused great indignation in the section affected; destruction of commerce was so serious that the opponents of the embargo, reversing the spelling, called it the "O-Grab-Me Act." It was repealed in 1809.

EMBROID'ERY. A kind of needlework that dates back to ancient times is embroidery, popularly called fancy work. It is the art of ornamenting silk, cotton, linen, or other fabrics by more or less elaborate stitches which form various patterns and designs. Embroidery is not to be confused with tapestry, in which the pattern is woven into the fabric.

Among the most beautiful of historic embroideries are those of the Chinese, Indian, Persian, and Italian people. The Jews, Romans, and Greeks learned the art from the ancient Assyrians and Egyptians. The oldest embroidery work was done on linen, wool, and cotton, but the Chinese and Japanese later did very elaborate work on silk. These embroideries have designs worked in brilliantly colored silk thread sometimes combined with gold and silver. The Persians, Hindus, and Turks often use pearls and beads in addition to the gold and silk thread.

In modern embroidery, a design is usually stamped in outline on the fabric to be decorated, and this fabric may be stretched over a steel or wooden frame for conven-



A SUGAR CANE STARTS OUT IN LIFE

The plant begins within the seed as an embryo (1), and breaks out through an opening in the seed's end. It grows rapidly (2), soon developing into a stalklet (3) and (4).

ience in sewing. Almost every home has some examples of embroidery, such as luncheon cloths, tablecloths, towels, pillowslips, and clothing. The fancywork sections of women's magazines frequently suggest novel ways of embroidering; and many department stores maintain fancy-goods departments that sell the stamped materials and embroidery threads, and also provide instruction books and teachers to assist those who are learning to embroider.

EMBRYO, *em'bri o,* **and EMBRYOLOGY,** *em bri ol'o je.* Every plant and animal develops from an embryo. For example, the egg contains an embryo within the shell, from which the baby chick hatches; the heart of a seed, beneath its tough outer coating, is the embryo from which a tiny plant sprouts. The embryo contains all that is necessary for a new life, provided it receives the treatment necessary for the undeveloped organism to grow. In the case of plants, heat and moisture are necessary. Eggs need heat, such as that provided when the hen nests.

Embryology, the study of embryos and how they develop, offers a fascinating field for experiment. Although scientists are continually learning more and more about the subject, there are many problems as yet unsolved.

EM'ERALD. A wealth of fable and superstition has been built around the beautiful green emerald, one of the precious stones. Known for many centuries, the stone was once supposed to have curative power, and it has long been used as a charm by primitive peoples.

The emerald is a variety of beryl, its green color being due to the presence of chromium. The stones are unusually soft, and large ones without flaws are very rare. The gems are mined in many parts of the world, but the largest supply comes from Colombia. They were known in Peru long before the Spanish conquest, and after that invasion were mined extensively. There is an Oriental "emerald" which, though green, is related to the ruby and is not an emerald at all.

EM'ERSON, Ralph Waldo (1803-1882). Probably no other writer and philosopher has had a wider influence on American life and thought than has "the Sage of Concord," Ralph Waldo Emerson. He brought the message that man may rise above a poor environment and become whatever he desires; that to be self-reliant is the basis of happiness and character.

Emerson was born in Boston. He came of a family which for eight generations had produced ministers. He was graduated from Harvard at the age of eighteen, and for the next three years taught school. Emerson became associate minister of a Unitarian church in Boston in 1829; and although he was very successful, he gave up preaching after a few years because he could not accept some of the rites of the Unitarian Church. In 1832 he went to England, where he became acquainted with some of the important literary figures of the day. Especially did he enjoy the companionship of Carlyle, and their friendship continued through correspondence for years.

In 1835, after his return to the United States, Emerson married Lydia Jackson and went to live in Concord, Mass., which was then the literary center of America. Near him lived the Alcott family, Thoreau, and Hawthorne. Soon after, he became an ardent member of the Transcendentalist movement and in 1836 published his first

BELOVED PHILOSOPHER
Ralph Waldo Emerson, the distinguished poet-thinker of nineteenth-century America.

book, *Nature,* which set forth his creed. He was one of the first editors of *The Dial,* a Transcendentalist magazine founded in 1840. In the meantime he had won many friends and attracted wide attention through a series of lectures begun in Boston in 1837.

Although Emerson was both an essayist and a poet, it was his essays that first gave him his reputation as a writer. The most important of these are contained in the books *Essays,* published in 1841, and *The Conduct of Life,* published in 1860. Among his poems, to which modern critics are attaching importance, the best known include *The Sphinx, The Humble Bee, The Threnody,* written on the death of his son, and *Each and All.*

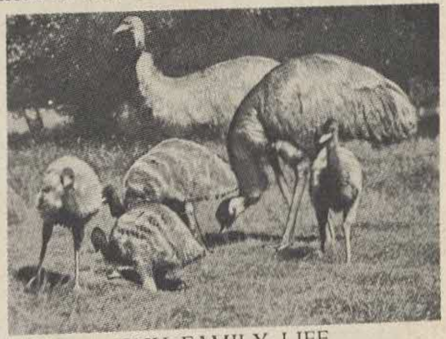
Perhaps the best remark ever made about Emerson is: "He is the friend and aid of those who would live in the spirit."

EM'ERY. When ground to powder, the blackish or bluish-gray emery stone is used in making emery wheels, emery paper, and emery cloth. It is also used for polishing glass and metals and for cutting gems. Emery not affected by heat or acids, is a kind of corundum and is composed mostly of alumina and quartz. See ABRASIVES.

EMIGRA'TION. See IMMIGRATION AND EMIGRATION.

E'MU. A close relative of the ostrich and the cassowary is the three-toed Australian emu. With small, useless wings, it is one of the birds which cannot fly. The bird does, however, have long, strong legs with which it can run very fast. The legs also serve as effective weapons, for the emu can kick with great force.

The bird has double feathers, there being two plumes to each quill. The covering of the neck and head is of rather hairy texture. The emu is distinguished from the ostrich and cassowary by the lack of a helmet, or casque. A large, ungainly-looking bird, the emu sometimes weighs as much as 130 pounds. It is very easily tamed and will survive in temperate climates. The Australian natives eat the flesh of this bird.



EMU FAMILY LIFE
Relatives of the ostrich, emus live in Australia. The young soon lose their stripes.

ENAMEL, *en am'el.* In the past, the art of enameling was somewhat similar to the art of painting; that is, it was a means of decorating metal or pottery objects with pictures or designs in color. The difference between the two arts lay in the medium, for enamel is not paint, but hardened glass, colored by being fused with various metallic oxides. Enamels are still widely used today for a variety of purposes and serve both to beautify and to protect surfaces. Kitchenware and some plumbing fixtures, for example, are often enameled.

An ancient art, enameling was practiced by the Assyrians, the Egyptians, the Greeks, and the Romans. The art has existed from an early date in the Far East also—in China and Japan. In Italy it became highly important. Many of the early Italian enamels have become valuable treasures of art.

The work is done by applying the fused glass, colored as desired, to metal or pottery surfaces in a predetermined pattern. Oxide of tin, for instance, produces white coloring in the molten glass; and, by the addition of a small amount of manganese, a remarkable brilliance is obtained.

ENCYCLOPEDIA, *en si ḵlo pe′di a,* **or CYCLOPEDIA.** This article is a part of an encyclopedia; it is a unit in an ordered collection of the world's knowledge. Many such collections deal with special subjects, going into great detail on the technicalities of one field. Works of this kind are to be had on medicine, engineering, history, and a host of other fields. All, however, aim to gather knowledge in a concise form and so arranged as to be readily usable. Such is the purpose of this set of books.

The term *encyclopedia* is derived from a Greek word which means *instruction in the circle of arts and sciences.* It refers to the so-called circle of knowledge which constituted the subjects an educated man should know. One of the oldest works in which knowledge was grouped in this manner was completed by the Roman scholar Pliny, in his *Natural History.* Several similar sets were produced during the Middle Ages, none of which, however, actually bore the title *encyclopedia* until the appearance of one in 1541.

The first alphabetically arranged encyclopedia in English came out in 1704, entitled the *Lexicon Technicum, or an Universal English Dictionary of Arts and Sciences.* Then, some years later, there appeared the first encyclopedia which contained cross references. This work was translated into French, during which process it was much enlarged. About the same time, similar works were published in several other countries.

Today, most encyclopedias are kept up to date by a continuous revision plan.

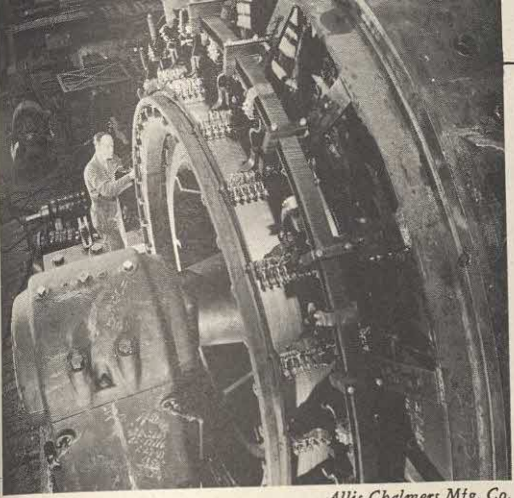
EARLY NEW ENGLAND LEADER
John Endicott led the first colonists to the Massachusetts Bay region.

Your WONDERLAND OF KNOWLEDGE will give you the answers to *who, what, where, when, why,* and *how.* In clear text and dramatic pictures, it gives you information about *persons, places, things,* and *ideas.*

ENDICOTT, JOHN (about 1588-1665). One of the courageous Puritans who sought freedom in the New World, John Endicott left his native Dorchester, England, in 1628, with a group of about 60 colonists. They settled in Naumkeag (later Salem), in the Massachusetts Bay region, and in April, 1629, Endicott became the first colonial governor of the settlement. In 1630, John Winthrop became the first governor of the chartered colony of Massachusetts Bay, but Endicott continued to take an active part in colonial affairs. In 1649 he succeeded Winthrop as governor, and held that office until his death, with the exception of two one-year terms.

Endicott was a stern governor, exercising strict discipline in religious and civic matters. The colony prospered under his guidance, but his fame is marred by his harsh policy toward the Quakers. Chief among his secular improvements was the establishment of a mint at Boston.

ENDIVE, *aN′deev.* Much esteemed for salads is this plant of the chicory family. Its crisp bitterness is a pleasing contrast to a tart and salty French dressing. Endive is cultivated in several varieties, the outer leaves being tied together during growth to blanch the inner leaves, which may be straight or curly.



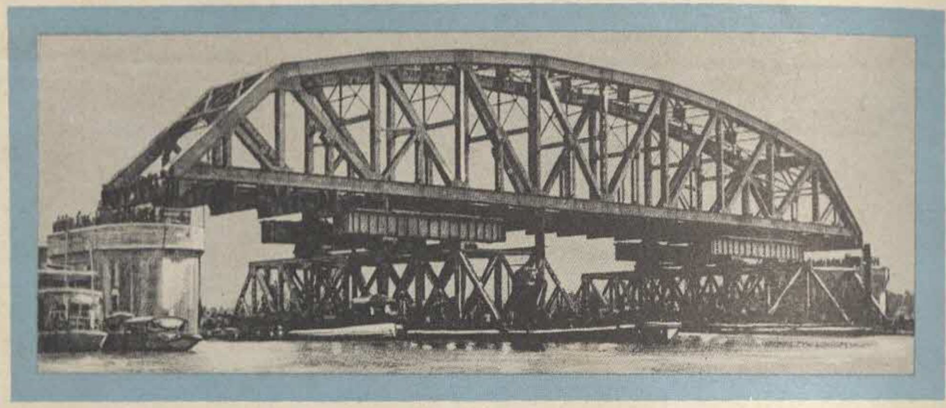
Allis-Chalmers Mfg. Co.

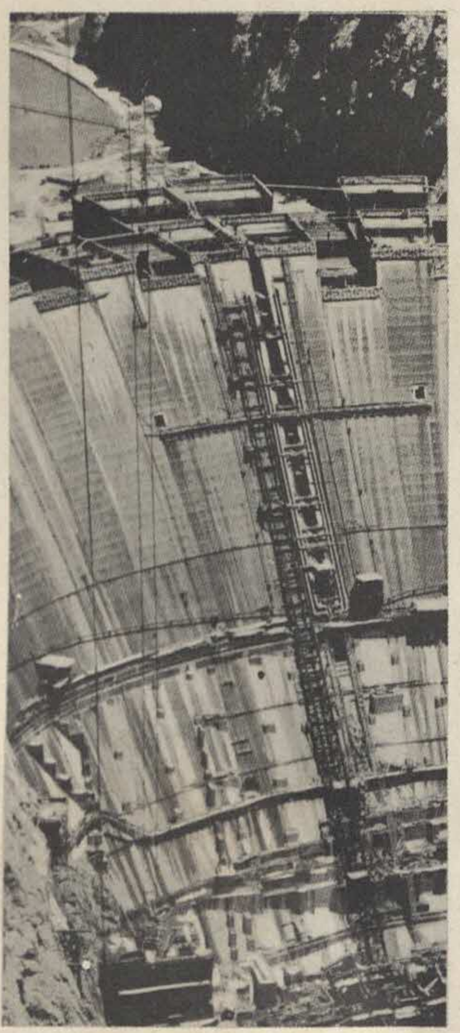
HARNESSED ENERGY
Huge motor produces 19,000 horsepower.

DOERS OF WORK
Examples of *kinetic* and *potential* energy: above, a swift-rushing stream, whose motion gives it kinetic energy; left, a spring. Compressed or stretched, it would have potential energy. Right, kinetic again, a water wheel.

EN'ERGY. Physics defines energy as the power to do work, or to produce or alter motion. The spring of a watch possesses energy when it is wound, for then it can make the wheels of the watch go around. A hammer possesses energy when it is lifted, for then it can drive a nail when allowed to fall. A moving baseball has energy; it can break a window or tip over a pail.

Potential Energy. A weight that has been lifted possesses energy because of its elevated position, but will not exert it unless dropped. A bow has energy when its ends have been bent out of their original position, but does not exert it until the string is released. Both weight and bow possess energy because of their position or shape and, consequently, have *potential* energy (*potential* means *having power*). Coiled springs and stretched or compressed rubber have potential energy, and rocks on mountain sides, water in reservoirs, compressed air, seeds waiting to germinate, coal





FIRST BUILT ON PAPER

Not a rivet was driven in the great bridge, not an ounce of concrete poured in Boulder Dam, that was not carefully planned. The engineer's job is to understand exactly, then to build.

or cordwood, and rays of sunshine also possess it.

Kinetic Energy. The revolving flywheel has energy because of its motion. So have a cannon ball flying through the air, running water, and vibrating molecules. They all possess energy because they are moving, and their kind of energy is called *kinetic*.

Measurement of Kinetic Energy. Energy is measured by the amount of work it has the power to do, and the same units are used to express the measure of both energy and work. A ten-pound weight lifted to a height of twenty feet possesses 200 foot pounds of potential energy, because it could do 200 foot pounds of work if allowed to drop, and it has required 200 foot pounds of work to raise it.

ENGINE. See GAS ENGINE; STEAM ENGINE.

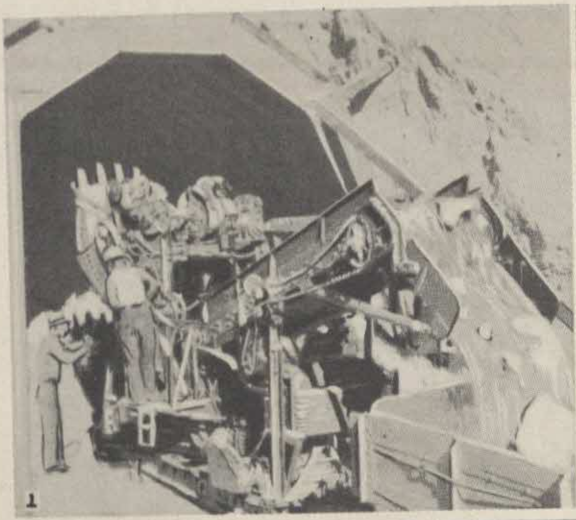
ENGINEER'ING. The gigantic Empire State Building towering hundreds of feet above the busy streets of New York; Boulder Dam, controlling tremendous volumes of water that are turning sandy wastes into green fields; and the Golden Gate Bridge across the entrance to San Francisco Bay, are all massive memorials to the science of engineering. But engineering today is more than just a feat of building; it is a career of labor, filled with hardships

Portland Cement Association

ENGINEERING SERVES EVERYONE

Motorists travel comfortably and easily on efficient highways such as the California freeway shown above. The grades, the curves, and even the material used in highway construction are based on modern engineering skills. Engineering is no less important in unexplored wilderness. The Forest Ranger, right, runs a line with a transit to establish a boundary line that may determine Federal or state ownership of land.

U.S. Forest Service Photo



ROMANCE AND SCIENCE

Engineers apply the laws of physics and chemistry to work miracles of construction. Theirs is one human activity in which mistakes are rare, because these apostles of accuracy leave almost *nothing* to chance. (1) An "underground dredge" which lifts muck and debris from the tunnel floor to disposal cars. (2) Measuring the inside of a new tunnel with a pantograph, which automatically makes a pen-and-ink record on the board. (3) A new vehicular tunnel almost complete. It needs only paving and lights.

Courtesy Union Pacific System

and dangers—labor performed so that man's life may be made easier and more pleasant than it could be otherwise.

Engineers and Their Work. The science of engineering is not new; indeed, the early Romans, who invaded England before the birth of Christ, were master builders of roads and aqueducts. But the breaking up of engineering into its several different branches is new. This division has been made necessary by the increasing complexity of the science of building. Today there are at least a dozen different kinds of engineering, each covering a distinct phase of the science.

Probably the most important of the many builders is the civil engineer, skilled in road and bridge building, a master in railroad, dock, canal, and harbor construction, and an expert in drafting, surveying, hydraulics, and mechanics. Moreover, he must be aware of new building materials that are being developed from time to time.

A branch of civil engineering is architectural engineering. The work of an architectural engineer, however, is confined to designing and erecting large buildings and skyscrapers.

Mine engineering is concerned with locating new veins and scources of minerals and ores. It is at the same time concerned with methods of getting the minerals out of the ground in the cheapest way and with the least waste.

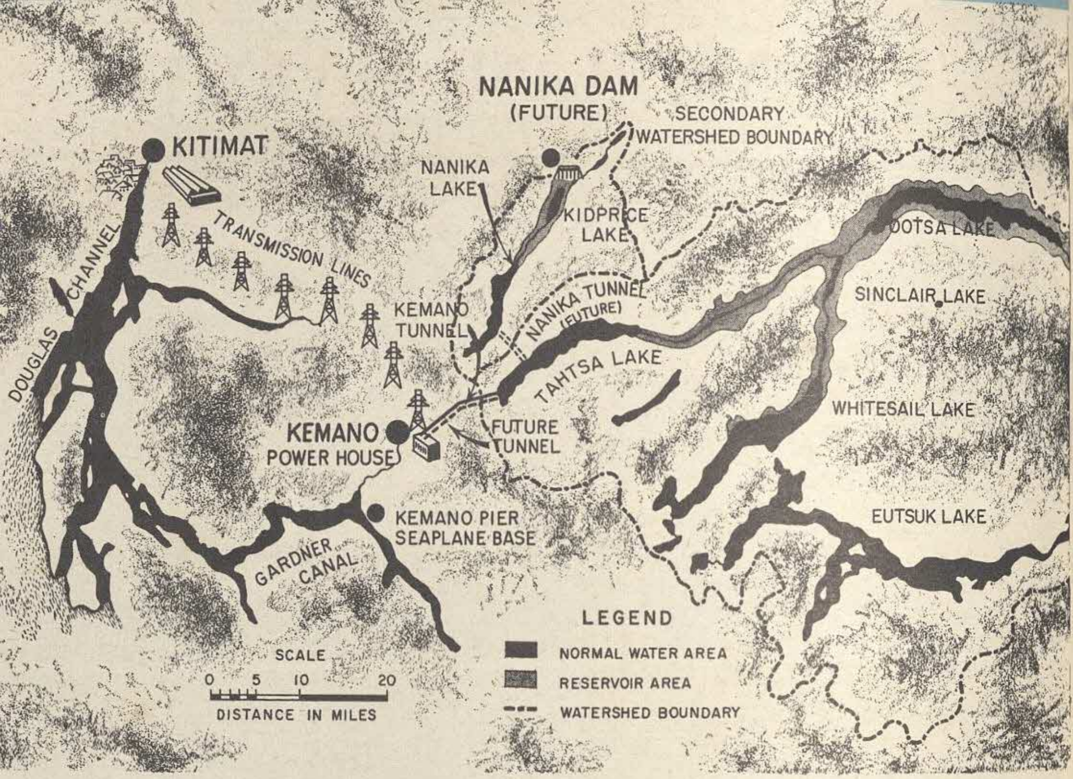
Ceramic engineers devote their entire time to converting clay and other earthy materials into chinaware, pottery, brick, tile, and other building materials, including cement. To the ceramic engineer goes the credit for the development of glass in

A WONDERLAND ADVENTURE IN ENGINEERING

MAN TAMES CANADIAN WILDS

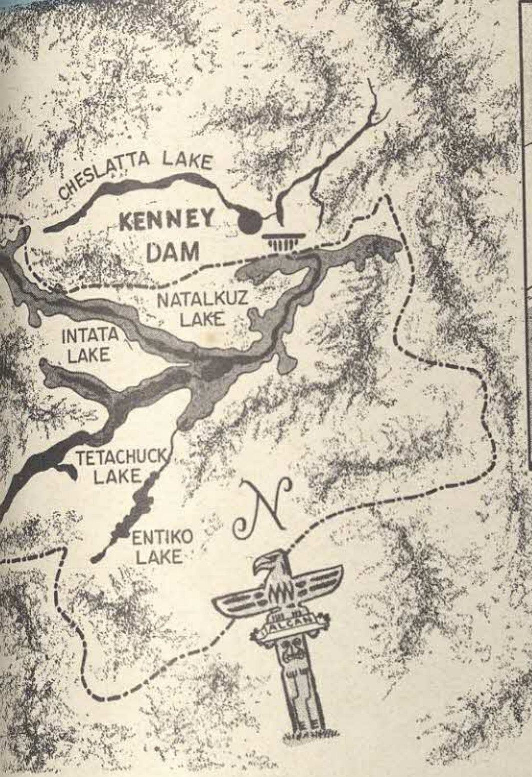
This snowbound weather station (above) is in the British Columbia wilderness that engineers made into the Kitimat industrial center in three years. They drove a 10-mile tunnel (below) through a mountain to carry water from lakes to turn giant generators to produce electric power. To carry the power, they built a 50-mile transmission line (right) across snowy mountains. Materials had to be flown in by helicopter.

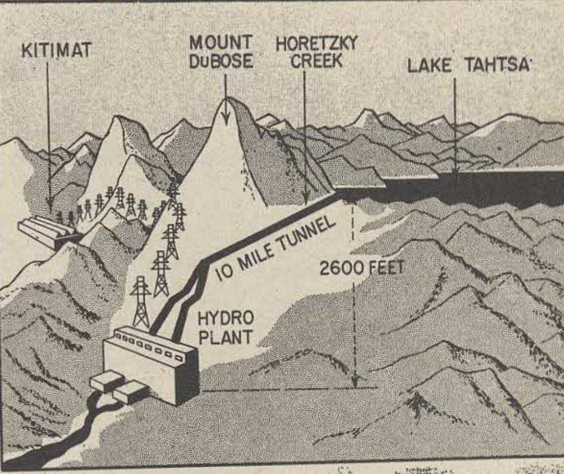
Aluminium Limited



WORLD'S LARGEST ENGINEERING PROJECT

The map shows where engineers achieved a "superman" task. Their problem: use water from mountain lakes to provide electric power to produce aluminum. To do this they performed five feats: (1) built the largest rock-fill dam in the world; (2) tunneled through a mountain; (3) built a mighty powerhouse; (4) constructed a transmission line to Kitimat (below), where (5) they built a smelter. They altered an area as large as Wales.

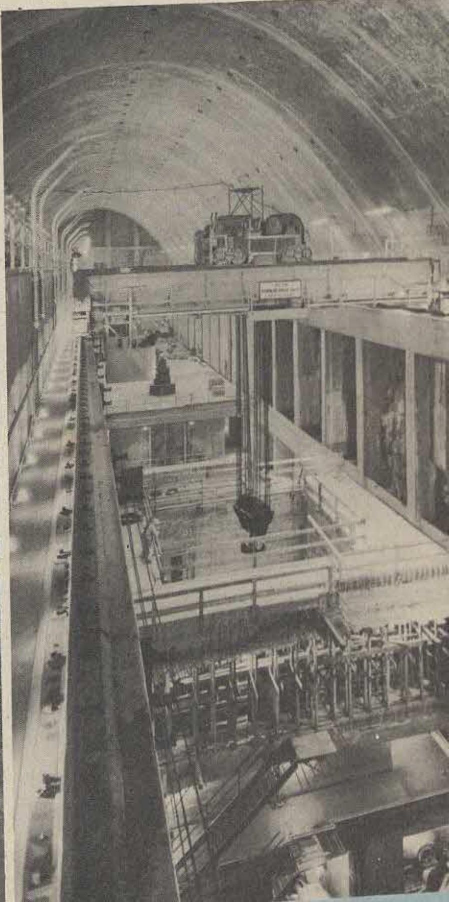




ALCAN'S BRITISH COLUMBIA PROJECT

ORE CARRIED 5,000 MILES

Three years after the task began, ships started to unload alumina ore from Jamaica at Kitimat (below), by the light of the midnight sun. Here, northern power wrests aluminum from tropical alumina. Right, part of the powerhouse, where giant generators, each producing 150,000 horsepower will eventually have a total capacity of 2,240,000 horsepower.



ALUMINUM GLEAMS IN TRIUMPH

Kitimat is now a leading center of aluminum production. It is designed to produce 550,000 tons a year.

WHEN THE ENGINEER'S TOOLS WERE MEN

Engineers built the Pyramid for Egypt's Cheops, using 100,000 slaves twenty years.

its many complex forms.

The mechanical engineer is concerned chiefly with the design and operation of the many types of engines, especially gas, steam, and Diesel. He must know the principles of steam, heat, and all other physical laws that affect his field.

Marine engineers must have a thorough knowledge of marine engines and navigation. Their work may be either civil or military, the former dealing with every type of vessel which is driven by gas or steam, from the smallest craft to the ocean liner. Military marine engineers deal with warships, mine laying, torpedoes, salvage, and other naval warfare details.

Sanitary engineers are primarily concerned with street cleaning, water supplies, and the proper disposal of the sewage of large cities.

Electrical engineers have been largely responsible for the lightening of man's labor. They work with electrical apparatus, motors, furnaces, and, in fact, everything electrical. This field, although not new, is far from exhausted. Electrical engineers are coming forward daily with new ideas, new theories, and inventions that harness electricity for the use of man. One of their biggest jobs is providing electrical power and maintaining the transmission lines that carry it from place to place.

The oldest type of engineering is military engineering. Originally it was concerned with much of the work now a part of civil engineering, such as the building of roads and canals. Modern military engineers plan fortifications and wire entanglements, operate searchlights, and design trenches. Upon military engineers hinges the success or defeat of armies in wartimes.

An engineer must be a mathematical expert, have a love of machinery, and believe in hard work; otherwise he will fail. But for the man who has these qualifications there is no limit to his endeavors, and there is no work more completely fascinating.

Consult the following articles for additional information:

Aqueduct
Bridge
Building
Canal
Dam
Roads and Streets

The SCEPTERED ISLE

ENGLAND is a southern country of the island of Great Britain, which is located off the northwest shores of Europe. England is part of the United Kingdom of Great Britain and Northern Ireland. It is slightly larger than the state of New York, but this small country welded together Great Britain, and later the large British Empire of the last three centuries. It is still the heart of the British Commonwealth of Nations.

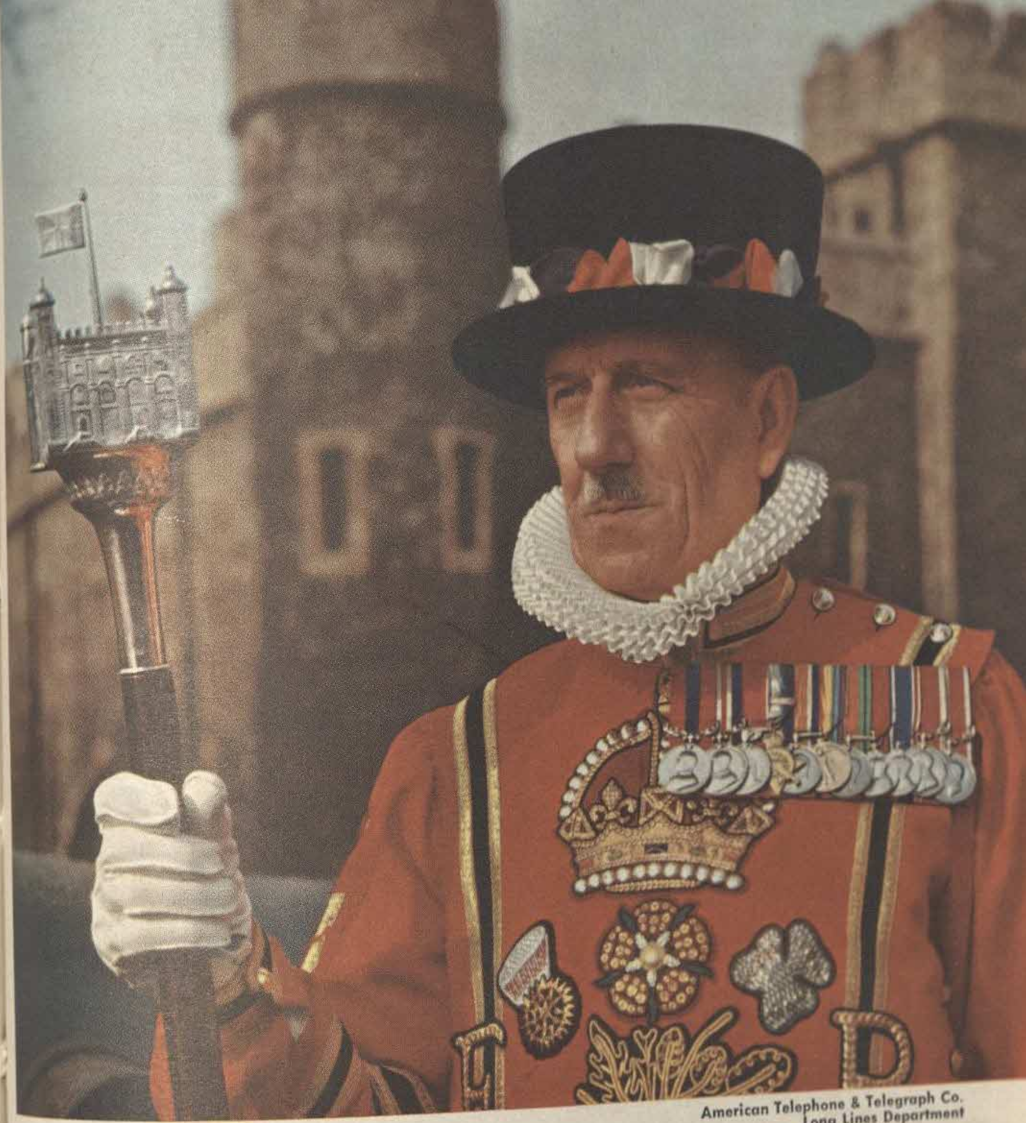
England occupies more than half of the island of Great Britain. Its largest city and the world's largest city is London, which, including the suburbs, has over eight million people living on an area of less than 700 square miles. The city is the governmental center of the vast British Empire, which once embraced nearly one fourth of all the land in the world.

Area and Population. The island of Great Britain consists of three main divisions: England, Scotland, and Wales. England lies in the south and Scotland to the north, and Wales is but a small peninsula jutting off to the west of England. Across the Irish Sea to the west is Ireland. Separated from the mainland of Europe by the English Channel, the Strait of Dover, and the North Sea, England nevertheless for centuries has influenced the political picture of the continent.

Its area is but 50,874 square miles; its greatest length from north to south about 365 miles; its width from east to west, 320 miles. Triangular in shape, it has a rough and rugged coast line, plentifully supplied with wide, deep harbors. Its population, with Wales, is about 44,000,000; this is more than three times as many people as live in the state of New York.

Over eighty per cent of the entire English population reside in cities; the average population per square mile is over 800. In no other European country are there so many persons to the square mile. The density of population in England is sixteen times that of the United States, which has about 50 persons per square mile. Besides London, England has eighteen cities with populations over 200,000, and almost twice that many between 100,000 and 200,000 each. Most important among them are Birmingham, Liverpool, Manchester, Sheffield, Leeds, and Bristol. Needless to say, manufacturing is the leading industry.

The English Landscape. Though hilly, England has no lofty mountains. Its countryside, nevertheless, has unique charm and beauty. As one approaches Scotland to the



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British "Beefeater" Stands Guard

Yeomen of the Guard are a colorful, familiar sight in London. Originally the corps had a very real duty — to guard the sovereign at home, on journeys, and on the battlefield. Today the duties are only ceremonial. Organized in 1485 by Henry VII, the corps is the oldest existing body of its kind. The grand duke of Tuscany first used the term "beefeater" in 1669 because of the members' large daily ration of beef.

north, the landscape becomes mountainous in character, one of the highest points being Cross Fell, with an altitude of about 3,000 feet. The Pennine Chain, in which this peak is located, begins near Central England and runs northwest to the Scottish border. The neighboring Cumbrian Mountains, lying in the extreme northwestern part of England, are slightly higher. England's highest peak, Scafell Pike (3,210 feet), is located in this range. Extending across rugged Wales from north to south are the Cambrian Mountains, and in the southwestern part of England several low ranges cover much of the counties of Cornwall, Devon, Somerset, and Dorset. The lowlands of Southern and Eastern England are varied by gently rolling hills and valleys. The best farming land of the country is found in this region.

Although there are but few lakes, Eng-

POMP AND SPLENDOR RULES

Past figures in the spectacular parade of England's time-honored monarchy. Regal grandeur has long been a living symbol of English unity and strength. Only once were Englishmen without a royal sovereign. The Cromwells, Oliver and Richard, governed from 1653 to 1659.

TOWARD A UNITED ENGLAND

Now almost a legendary figure, Alfred the Great ruled England in the ninth century. Here proud lords of Britain are acknowledging his sovereignty after his victory over the Danes.

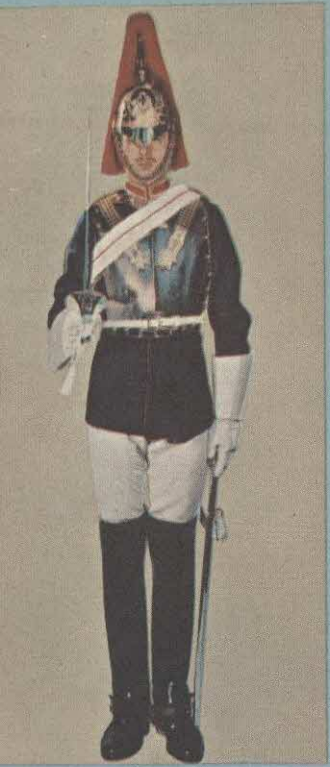
land's Lake District, in the extreme northwest, is widely known for its beauty. There are many rivers of great commercial value in this small country. Most important is the Thames which flows through London and empties into the North Sea. Farther north are the Ouse and Humber, also emptying into the North Sea. Other important commercial streams are the Mersey, which empties into the Irish Sea at Liverpool, and the Severn, flowing southwest into the Bristol Channel.

Climate. Although London lies nearly a thousand miles north of New York, its climate is kept mild by the warm waters of the Gulf Stream that flow along the English coast. Summers are delightfully cool, and winters are much milder than those of New York. Rainfall is plentiful. London has the most disagreeable weather where dense fog, known as "pea soup," occurs often and is made worse by smoke and soot from the factories.

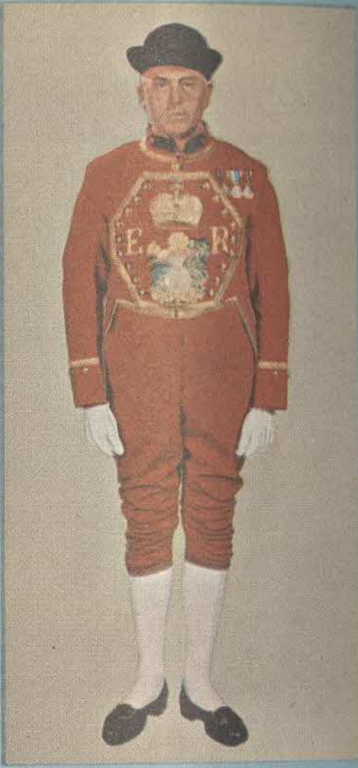
Resources. The mineral deposits of England are among the most varied in the world. Tremendous veins of coal, iron ore, and clay are located there, and many millions of England's people earn their living by mining. The coal-mining district extends north and south near the center of the country. Nearby are extensive iron ore and limestone supplies, making central England a natural iron-manufacturing region. Tin is mined in the mountainous areas of Devon and Cornwall. Copper, zinc, salt, and gypsum are present in lesser amounts in England.

Fish is plentiful. Haddock, herring, mackerel, and cod are caught off the coasts of England and Wales. Hull, Yarmouth, and Grimsby are the "fishing towns," and nearly the entire catch is shipped to London.

Industrial England. Most of England's wealth is dependent on its manufactures and exports. London, primarily a banking, commercial, educational, and government center, also has large chemical and dye works, clothing manufacturers, silk mills, breweries, and sugar refineries. Central England is the center of manufacturing.



The pomp and pageantry of "Merrie Old England" can be seen in the colorful uniforms used in Her Majesty's household. One of the uniforms of the Household Cavalry is that of the Royal Horse Guards, left. This regiment was formed after Charles II was restored to the throne in 1660. It is far more than an honorary service. Men of this regiment have served with distinction in many parts of the world. The royal barges used to be a familiar sight on the Thames River, but no more. However, the Queen still has her Bargemaster, right. He can be seen at the State opening of Parliament—riding on a coach. Another scarlet-frocked member of the Royal Household is the Royal Choir Boy, opposite page. These young choristers can be heard during the fall and winter.



Birmingham is the "Pittsburgh of England," because most of the great steel mills are located there.

Sheffield lies farther north, also a steel town, but especially noted for its fine cutlery. Leeds ranks first in the manufacture of woolens, and Manchester, lying between Sheffield and Liverpool, is the country's greatest cotton-manufacturing center.

Liverpool, second ranking seaport of England, has a heavy export and import trade. Shipbuilding yards, dry docks, and wharves dot its busy waterfront. England is one of the world's greatest manufacturing countries because of its great supply of coal and iron, fine shipping facilities, mild climate, and industrious people.

Life in the Country. Unlike the farms of the United States, most of the English farms are small, cut into irregularly shaped fields and separated by stone walls or hedges. Most of the land is owned by proprietors of large estates, who rent out the farms to tenants. Generations of tenants often operate the same farm and develop a feeling of ownership.

Farming consists chiefly of grain crops, such as wheat, barley, and oats. Potatoes and garden vegetables also form a large part of the annual farm production. Stock raising is important because of the heavy rainfall and luxurious grass. Several fine breeds of livestock, including Durham and Devonshire cattle, Cotswold and Southdown sheep, and Berkshire hogs, originated here.

Women had to learn farming during the two World Wars. With labor-saving equipment, grain production reached a new high, partly because pastures and woodlands never before farmed were brought under production. However, England must still depend on imports for most of the food supply of the people.

England's Sea Power. Located on a comparatively small island, with a coast

Color Photos
British Travel Association

The guardsman on sentry duty at Whitehall, right, is an impressive sight to children in London. Adults find the colorful uniform with its shining steel and leather accessories equally fascinating. Sentry duty is very demanding, but the men take a great deal of pride in their ability to stand absolutely motionless, regardless of curious crowds.

British Information Services, by Special Permission

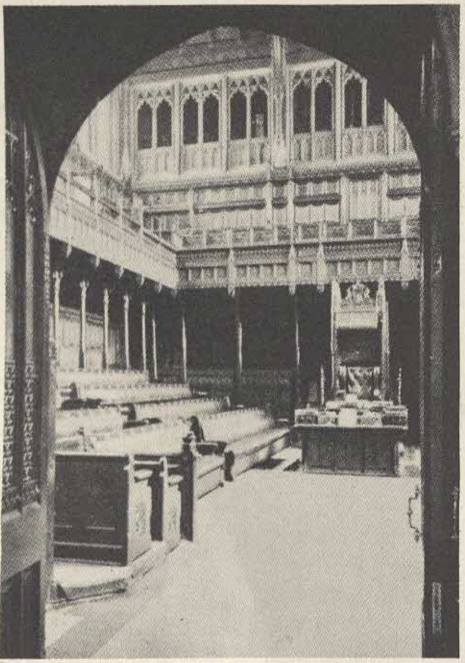
line of over 2,000 miles, a dense population, and a limited area, England has been forced to give most of her attention to sea-borne commerce in order that food and raw materials might be imported and a wide market found for the country's manufactures. Unexcelled as colonizers, English explorers of early times covered the globe, claiming rich, productive lands for the Mother Country. These lands have supplied a home for the overflow population, as well as a wealth of raw materials. The countries which were largely settled by British subjects, such as Australia, the Union of South Africa, and Canada, have been made self-governing nations in the British Commonwealth.

England's imports consist chiefly of grain, ores, cotton, wool, raw silk, hides, and rubber, totaling about $11,000,000,000 in an average year. Exports, amounting to nearly $9,600,000,000 in a year, consist principally of coal, woolen and cotton goods, iron and steel products, machinery, vehicles, and chemicals. London, the chief shipping point, ranks second only to New York among the ports of the world.

The People. No people on earth show more characteristic national traits than the English. They are outstanding in their persistence, never seeming to know the meaning of defeat. It has been said that an English soldier could "fight as long as any other —and fifteen minutes longer." While not a typical fighting people, the English have found it necessary to protect their homeland and extensive empire with a large navy and well-trained army.

Strongly intellectual and inventive, Englishmen have contributed much to the world of science. The law of gravitation, the theory of evolution, the steam engine, the locomotive, the power loom, the Bessemer steel process, and innumerable discoveries in the fields of chemistry and medicine, are among the many contributions to science which have been made by English-

Wide World



ENGLAND'S AGE-OLD PAGEANTRY

The English combine democracy with the thrilling spectacle of gilded royalty. A wealth of tradition lends dignity. Above, the Royal State Coach en route to the 1937 coronation. Left, the House of Commons, bombed in World War II.

men. Some of the finest literature of the world has been written in Great Britain, including the works of Shakespeare, Bacon, Browning, Tennyson, Burns, Wordsworth, Keats, Shelley, Bunyan, Macaulay, Kipling, and a host of others.

Industrious, too, are the English, for they have continually made the best of the circumstances at hand. A large part of English history is made up of the story of the struggle of the people for their rights, for they seem to grow stronger under adverse conditions. Like the Germans and the Scandinavians, whose descendants they are, the English are great believers in cleanliness. Crowded, smoky cities have hindered this trait, but in the country everything is immaculately clean.

Education. Up to the time of World War I, England's educational system was a loosely constructed organization. In 1918, however, Parliament passed, and the king signed, an act co-ordinating this important phase of English life. Effective in both England and Wales, the act provides both elementary and continuation schools, half the expense of which is borne by the na-

Philip Gendreau

LANDMARKS OF LONDON
Drawbridge of Tower of London Bridge, above, lifts for Thames River traffic. Nearby, the centuries-old Tower of London, right. Its gates have opened to many famous prisoners. The crown jewels are still kept here.

London Midland & Scottish Railway Co.

tional government. Education for children from five to fifteen years of age is now compulsory. In case a child has been deprived of his early education, he must attend a continuation school for 320 hours per year until he is eighteen. Child labor for children under twelve years of age is also forbidden.

The wealthier classes of England, now, as always, send their children to private schools, known, however, as "public schools." Outstanding among these are the boys' schools of Rugby and Eton. There are many fine English universities, the oldest and most noted being Oxford and Cambridge. London, Manchester, Sheffield, Liverpool, Leeds, Birmingham, and Durham are also sites of universities.

England's Colorful History. Long before the birth of Christ, the Greeks, Phoenicians, and Carthaginians were accustomed to come to England for their supply of tin. Britain was first conquered by Julius Caesar in 55 B. C., but no effort at colonization was made until nearly a hundred years later. It was not until the time of Agricola, about A. D. 77, that colonization began in earnest. Though the island was never completely conquered, Roman civilization spread over Southern Britain, fine roads and aqueducts were built, towns sprang up, and Christianity was introduced.

But in the fifth century, the Roman armies were recalled to protect Rome, and the country gradually fell into the hands of the Jutes, Saxons, and Angles, the ancestors of the English of today. Almost constant warfare was waged between the Angles and Saxons until 827, when Egbert, king of Wessex, conquered the whole country for himself. He called the island "Angle-land," which was later shortened to its present form of "England." During the struggle between the Angles and Saxons, Christianity and the Roman civilization had been wiped out and were replaced by Scandinavian mythology. Christianity was reintroduced, however, by Saint Augustine, in the sixth century.

The Danes meanwhile had been making raids upon the English coast, and by 871, when Alfred the Great came into power, they were in possession of a large part of the island. By restricting them to certain lands, he kept them under control and made them his subjects. His successors had considerable trouble in keeping the Danes within their territory. By 1013, the Danes under Sweyn again controlled the greater part of England; and Sweyn's son, Canute, firmly established himself as monarch of the land in 1016.

Descendants of Canute held sway until 1042, when the English line of kings regained power under Edward the Confessor. But Edward died in 1066 and was replaced by Harold, his brother-in-law. Harold's rule was short-lived, for in that same year he was killed and his army defeated in the famous Battle of Hastings. The opposing army in this battle was made up of Normans from France under William the Conqueror. William claimed to be a descendant of the royal Saxon line and further claimed that the throne had been promised him by Edward. Consequently, after quickly subduing a large part of the country, he had himself crowned in London. But it was many years before he and his successors were able completely to dominate the island.

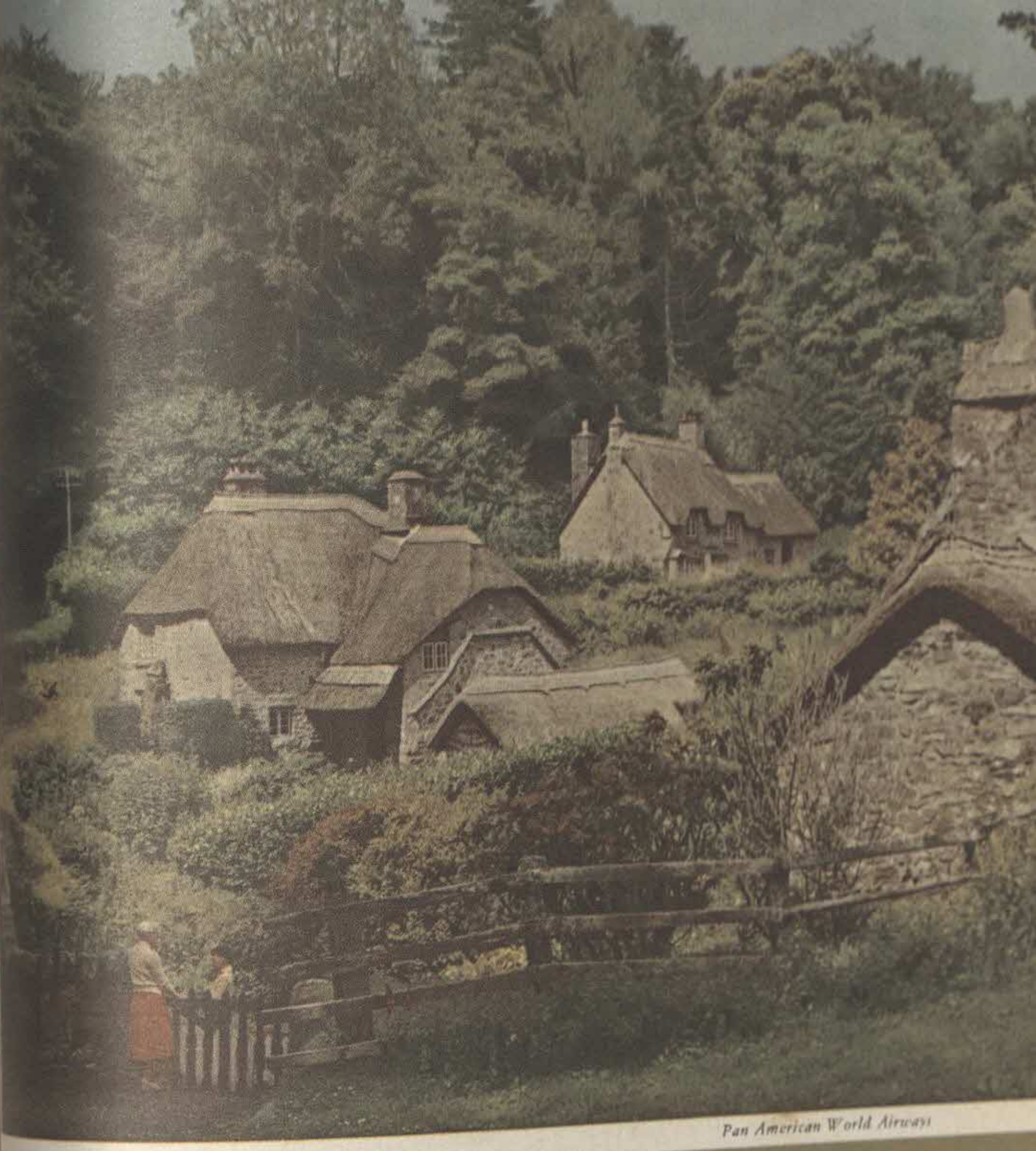
Upon William's death, he was succeeded by his second son, William II, who died in 1100. He in turn was followed by his younger brother, Henry I, who held the throne and added the province of Normandy to his kingdom, in spite of the efforts of his oldest brother, Robert II, to gain control. Henry planned to place his daughter Matilda on the throne after his death, but Stephen, a grandson of William the Conqueror, gathered together an army and attempted to seize the throne. After much fighting, he succeeded, but after his own son's death he was compelled to agree that Matilda's son, Henry, should succeed him. The year 1154, when Henry II came into power, marked the beginning of the dynasty of the Plantagenets.

The rule of Henry II was outstanding, for he established law and order after putting an end to the lawless raids of the feudal barons on the unprotected countryside. In a spirited contest with the Pope he was forced to submit, but he weakened the control of the Church over England. Henry spent only a part of his time in England, for he had vast possessions in France to oversee. His son, Richard the Lion-Hearted, who ruled from 1189 to 1199, stayed at home but one year of his reign, spending most of his time as a leader of the Crusades.

John (1199-1216), who succeeded Richard, was a weak ruler and lost all of the English possessions in France. He was forced, moreover, to sign the Magna Charta, relinquishing much of his power to the people. This was the real beginning of self-rule among the English. John was succeeded by his son, Henry III, who reigned until 1272. It was during his reign that the first House of Commons was assembled.

Edward I, who ruled from 1272 to 1307, was a strong king. He not only restored order in the nation, but brought Wales under English control. Under his reign and that of his son, Edward II, a fierce war with Scotland took place, culminating with the independence of Scotland in 1314 after the Battle of Bannockburn. Under Edward III (1327-1377) began one of the most gigantic wars in England's history, the Hundred Years' War with France. In spite of the fact that the struggle was a costly affair, the war had no outstanding results other than the uniting of the Normans and Saxons and the strengthening of Parliament, upon whom the kings had to depend for supplies.

Edward's reign was followed by that of Richard II (1377-1399), a weak king who lost the throne to Henry of Lancaster, after an insurrection. Henry's reign was marked by frequent uprisings by the followers of


Pan American World Airways

ENGLISH VILLAGES DREAM THROUGH THE CENTURIES

The English are justly proud of their lovely old villages that dot the countryside. Homes like the ones above, with their sturdy stone walls and picturesque thatched roofs, have a special charm all their own. Generations of families have shared these homes, building traditions and customs that are handed down from father to son. Street addresses are unknown—the homes are usually called by individual names. Many of the villages have a "great house"— the home of a nobleman, complete with its share of legends and ghosts. Village living is quiet and unhurried. A boy delivers milk on his bicycle, amateur gardeners take an intense pride in their prim hedges and colorful gardens, and the annual flower show can be the most exciting event of the year.

A British Council Photograph

PEACEFUL INDUSTRY ON ROLLING ENGLISH FARMLAND
English farmers harvest the ripe grain in the beautiful county of Devon.

Richard and by the growth of constitutional power, for it was by authority of Parliament that he was able to attain the throne. His successor, Henry V (1413-1422), spent the greater part of his reign in the wars against France, and so successful was he that he forced Charles VI of France to promise the French throne to an English successor upon his death.

Henry VI, the son of Henry V, being young and inexperienced, was compelled by the French to give up all claims to the French throne, largely through the heroism of Joan of Arc. Also under his rule began the Wars of the Roses, during which he lost and regained the throne many times. He was finally displaced by Edward IV, head of the House of York. He and his son, Edward V, held sway but a short time before Richard III usurped the throne, only to be overthrown himself by Henry VII.

The first of the Tudor Dynasty, Henry re-established great power for himself and his successor, Henry VIII. Under the reign of Henry VIII began the Reformation, a struggle between the king and the Pope. His son, Edward VI (1547-1553), carried on the work of the Reformation, but following the reign of Edward came Henry's daughter Mary, who favored the Catholics and attempted to crush the Reformation. Failing in this, she was followed on the throne by her half-sister Elizabeth (1558-1603), who carried on the Reformation movement and established herself as head of the Church of England. During her reign, Britain became a powerful nation, bringing Ireland under subjection and defeating the Spanish Armada.

Following the death of Queen Elizabeth, James I, son of Mary, Queen of Scots, and formerly James VI of Scotland, came to the throne—the first monarch under the House of Stuart. Under his rule, attempts were made to unite England and Scotland under one government but this union was not completely effected until about a century later. James experienced much trouble with Parliament, for it was his idea that "the king can do no wrong." Under his rule, settlements were established in Virginia and Massachusetts. In his reign the King James Version of the Bible was issued.

His son, Charles I (1625-1649), experienced even greater trouble with Parliament than had his father. After dissolving two Parliaments, he was forced to assent to the Petition of Right, but ruled for nearly twelve years as an absolute monarch without a Parliament. He unmercifully persecuted the Puritans. Finally, after trouble broke out in Scotland, he called a meeting of Parliament in 1640, in order to secure financial aid to quell the disturbance. But Parliament impeached the king's ministers, his army met defeat in Scotland, and he finally surrendered to Parliament. In 1649 he was tried, convicted, and beheaded.

Oliver Cromwell, Parliament's strongest man, succeeded Charles as head of England and as Lord Protector ruled with an iron hand until his death in 1658. His son and successor proved too weak to carry on his father's task, and by 1660 the royalists were back in power with Charles II as their ruler. During his reign (1660-1685), the moral tone of the nation was low, and the country was little more than a dependency of France.

Charles was succeeded by his brother James, who, being a Catholic, was unpopular. The nobles of the land, fearing the spread of Catholicism, in 1688 made overtures to William of Orange and Mary, son-in-law and daughter of James. When William arrived in England with an army, James fled to France. In 1689 William and Mary were crowned rulers of England.

The reign of William III marked the return to constitutional government and was largely taken up with a war against Louis XIV of France. His death came as he was preparing for another campaign against Louis. William was succeeded by Anne (1702-1714), the second daughter of James II. She carried his plans forward and brilliant military successes by Marlborough in the War of the Spanish Succession were won under her rule. It was also during the colorful reign of Anne that a real union with Scotland was finally brought about. The history of the nation since 1714 is continued under the story of GREAT BRITAIN. Consult the following titles for additional information:

GEOGRAPHY

Birmingham
British Empire
Channel Islands
English Channel
Exeter
Greenwich
Land's End
Liverpool
London
Manchester
Thames (river)

HISTORY

Anglo-Saxons
Armada
Boyne, Battle of the
Cavaliers
Commonwealth of England
Crecy
Crusades
Domesday Book
England, Church of
Feudal System
Field of the Cloth of Gold
Gunpowder Plot
Hastings, Battle of
Hundred Years' War
Lancaster, House of
Long Parliament
Magna Charta
Normans
Petition of Right
Plantagenet
Reformation, The
Renaissance
Roses, Wars of the
Tower of London
Tudor
York, House of

BIOGRAPHY

Alfred The Great
Bruce, Robert
Canute
Cromwell, Oliver
Edward, the Confessor
Edward, the Black Prince
Harold I
Joan of Arc
Mary Stuart
Montfort, Simon de
Raleigh, Sir Walter
Tyler, Wat

ENGLAND, CHURCH OF. Christianity was first introduced into England by the Romans, but it was not generally adopted until the sixth century, and then as a result of the efforts of Saint Augustine. Early English churches were Roman Catholic. The present Church of England was set up in the reign of Henry VIII as the outcome of the struggle between Henry and the Pope. Not only did this bold king abolish the Papal authority in England, but he dissolved the monasteries, spent the funds of the Church on his court, and declared himself the new head of the Church of England.

This drastic action slowed up the progress of the Reformation, but the movement was continued by Edward VI, son and successor of Henry. When, however, the throne was ascended by Mary, sister of

Edward and a staunch Catholic, the movement again ceased. Not until the reign of Elizabeth, who succeeded Mary in 1558, was the final separation from the Catholic Church effected. The Thirty-Nine Articles, the statements of belief and faith for the Church of England, were drawn up at that time.

How the Church is Organized. The Church has no formal constitution, but is governed by about 150 canons or Church laws. It is the privilege of Parliament and the king to pass any law needed for the guidance of the Church. For important changes in policy, a convocation is called. Jurisdiction over the entire Church of England is vested in the Archbishop of Canterbury, just as the Pope governs the entire Roman Catholic Church. England is divided into two provinces—Canterbury and York—with an archbishop governing each. Provinces are further divided into dioceses, with a bishop over each. Next in order are the archdeacons, deans, canons, prebendaries, rectors, vicars, and curates. The corresponding body in the United States is the Protestant Episcopal Church.

In the Church membership there are three distinct groups: the High Church, whose adherents accept many of the beliefs and forms of worship of the Catholic Church; the Low Church, comprising those who believe in simplicity of worship and emphasis on Protestantism; and the Broad Church, a middle group.

ENGLISH CHANNEL. Separating England from the mainland of Europe is the English Channel, one of the busiest stretches of water in the world. On the English side, the Channel extends from Dover to Land's End; on the French side, from Calais to the Island of Ushant. Joining the North Sea with the Atlantic Ocean, the Channel is one of the chief outlets of Northern Europe to world trade routes. Windswept and churned by crosstides, the Channel is notorious for its roughness and is difficult to cross.

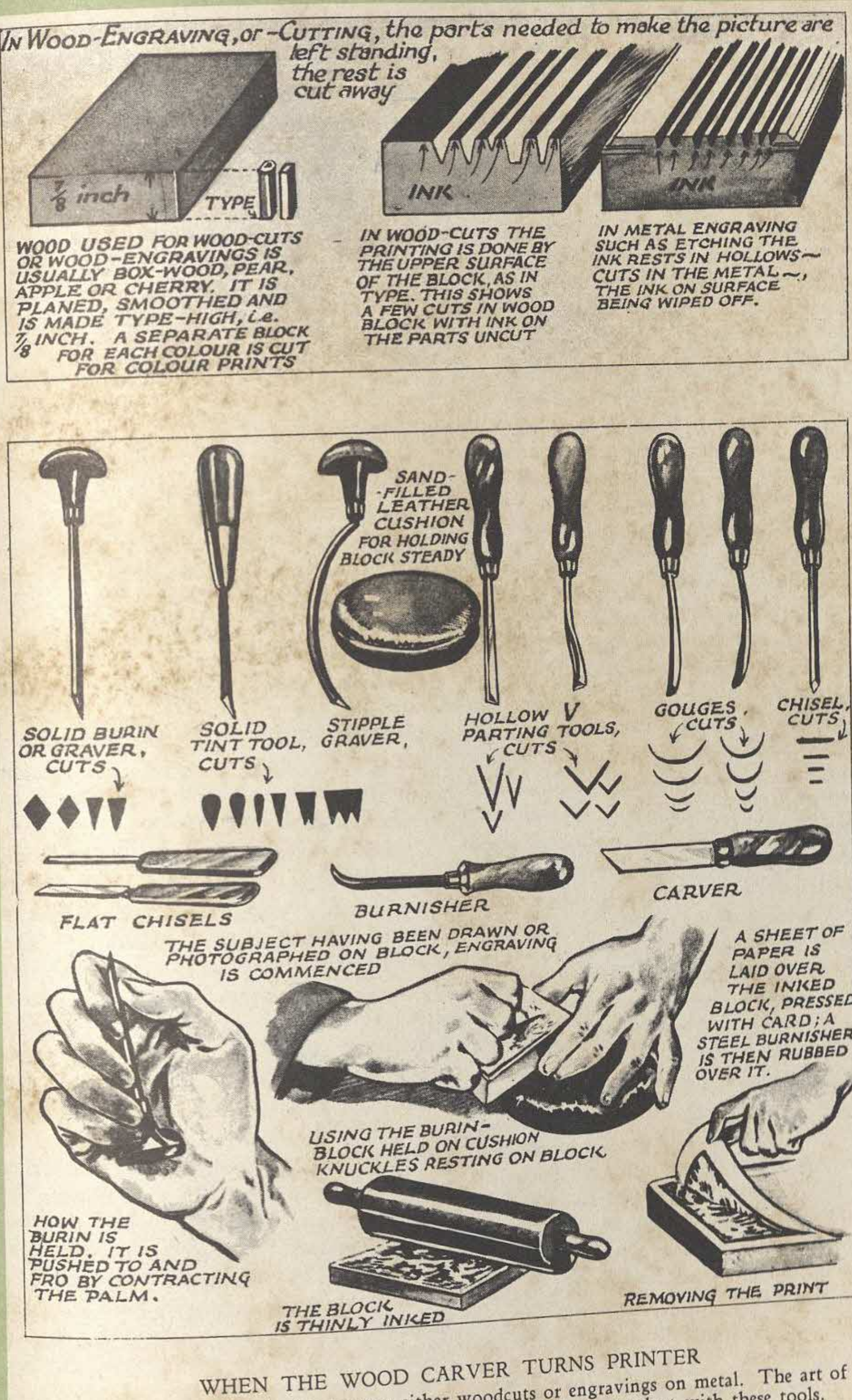
Called "the sleeve" by the French, the Channel is 140 miles wide at its widest point, and only twenty miles wide in the Strait of Dover, its narrowest point. Chief among the Channel ports are: Southampton, Plymouth, Falmouth, and Dover in England; Calais, Havre, and Boulogne in France. Cherbourg is an important landing place for tourists, though its harbor is not deep enough for the largest ocean liners, and passengers are taken ashore in tenders. See DOVER, STRAIT OF.

ENGLISH LANGUAGE. Originating in the British Isles and spreading to many colonies and to America, the English language has become one of the leading tongues of the world. When the Anglo-Saxons invaded England in the fifth and sixth centuries, the tribes of England were speaking a Celtic dialect; and remnants of the Celtic language are still found in Wales, where the Celts were driven by the invaders. The true basis of the English language, however, is Anglo-Saxon.

Later, after the Norman Conquest in the eleventh century, French was introduced and was made the official language of the court. Though the people refused to adopt this new tongue, it gradually became mingled with the Anglo-Saxon, and by the year 1250 the English language was a combination of the two. The common words of the new language, pertaining to the home, farm, and everyday life, were Anglo-Saxon; words applying to the courts, sport life, laws, and society were chiefly derived from the Norman speech.

During the period when the English Catholic Church was at the height of its power, and in the Reformation that followed, the Italian influence made itself evident and many words of Latin origin were added to the English language. Developments in both science and medicine have brought a host of Latin and Greek terms into this speech.

From a total of about 30,000 words in the thirteenth and fourteenth centuries, based on Anglo-Saxon, the language has expanded to a volume of over 500,000 words, many of them derived from foreign tongues. Yet the grammatical construction


IN WOOD-ENGRAVING, or -CUTTING, the parts needed to make the picture are left standing, the rest is cut away
7/8 inch
TYPE
INK
INK
WOOD USED FOR WOOD-CUTS OR WOOD-ENGRAVINGS IS USUALLY BOX-WOOD, PEAR, APPLE OR CHERRY. IT IS PLANED, SMOOTHED AND IS MADE TYPE-HIGH, i.e. 7/8 INCH. A SEPARATE BLOCK FOR EACH COLOUR IS CUT FOR COLOUR PRINTS
IN WOOD-CUTS THE PRINTING IS DONE BY THE UPPER SURFACE OF THE BLOCK, AS IN TYPE. THIS SHOWS A FEW CUTS IN WOOD BLOCK WITH INK ON THE PARTS UNCUT
IN METAL ENGRAVING SUCH AS ETCHING THE INK RESTS IN HOLLOWS—CUTS IN THE METAL—, THE INK ON SURFACE BEING WIPED OFF.
SAND-FILLED LEATHER CUSHION FOR HOLDING BLOCK STEADY
SOLID BURIN OR GRAVER, CUTS
SOLID TINT TOOL, CUTS
STIPPLE GRAVER,
HOLLOW V PARTING TOOLS, CUTS
GOUGES, CUTS
CHISEL, CUTS
FLAT CHISELS
BURNISHER
CARVER
THE SUBJECT HAVING BEEN DRAWN OR PHOTOGRAPHED ON BLOCK, ENGRAVING IS COMMENCED
A SHEET OF PAPER IS LAID OVER THE INKED BLOCK, PRESSED WITH CARD; A STEEL BURNISHER IS THEN RUBBED OVER IT.
USING THE BURIN-BLOCK HELD ON CUSHION KNUCKLES RESTING ON BLOCK
HOW THE BURIN IS HELD. IT IS PUSHED TO AND FRO BY CONTRACTING THE PALM.
THE BLOCK IS THINLY INKED
REMOVING THE PRINT

WHEN THE WOOD CARVER TURNS PRINTER

In the past, most printed pictures were either woodcuts or engravings on metal. The art of making the blocks was highly developed. You can make a woodcut with these tools.

and the ordinary everyday words of our speech are, for the most part, from the simple, forceful Anglo-Saxon.

ENGLISH LITERATURE. See Literature.

ENGRAV'ING. Crude artists of the Stone Age scratched man's first engravings on the soft stone walls of caves with a tool of flint or obsidian. Many of these earliest pictures have been discovered in modern times; they show that engraving is one of the oldest of the arts.

Fundamentally, engraving is cutting designs into smooth, enduring surfaces. Its original function was decoration, but when it came to serve as a means of transferring designs to other surfaces, its permanence and influence as a skilled craft was assured.

Seal rings for making wax impressions, ninth-century Chinese printing blocks of carved wood, the rich chasing of medieval armor and church furnishings, the elaborate works of master goldsmiths, like Cellini—all played a part in developing engraving for its importance in modern art and printing.

Metal plates for printing pictures, designs, and letters are made by cutting smooth copper, zinc, aluminum, and steel sheets with sharp tools (burins) or etching them with acid. Prints or impressions produced by inking these plates and pressing them on paper, of course reflect the depth and character of the lines on the plate and the manner in which they were cut. By modern methods, all tones from solid black to lightest gray, and all subjects which can be pictured, are accurately reproduced on metal printing plates.

Wood engravings are cut on hard blocks —of Turkish boxwood, for example—with very sharp carving tools. Prior to the universal use of photoengraving in commercial printing, artists achieved great skill in engraving detailed illustrations for books on both metal and wood.

Lithography differs from engraving in that impressions are transferred to paper by oil inks retained by grease-penciled areas on a smooth wet stone.

For further information, consult the following articles:

Etching
Lithography
Photoengraving
Photogravure

ENSIGN, *en'sine.* See Rank.

ENTOMOL'OGY, a branch of zoölogy that treats of insects. See Insects.

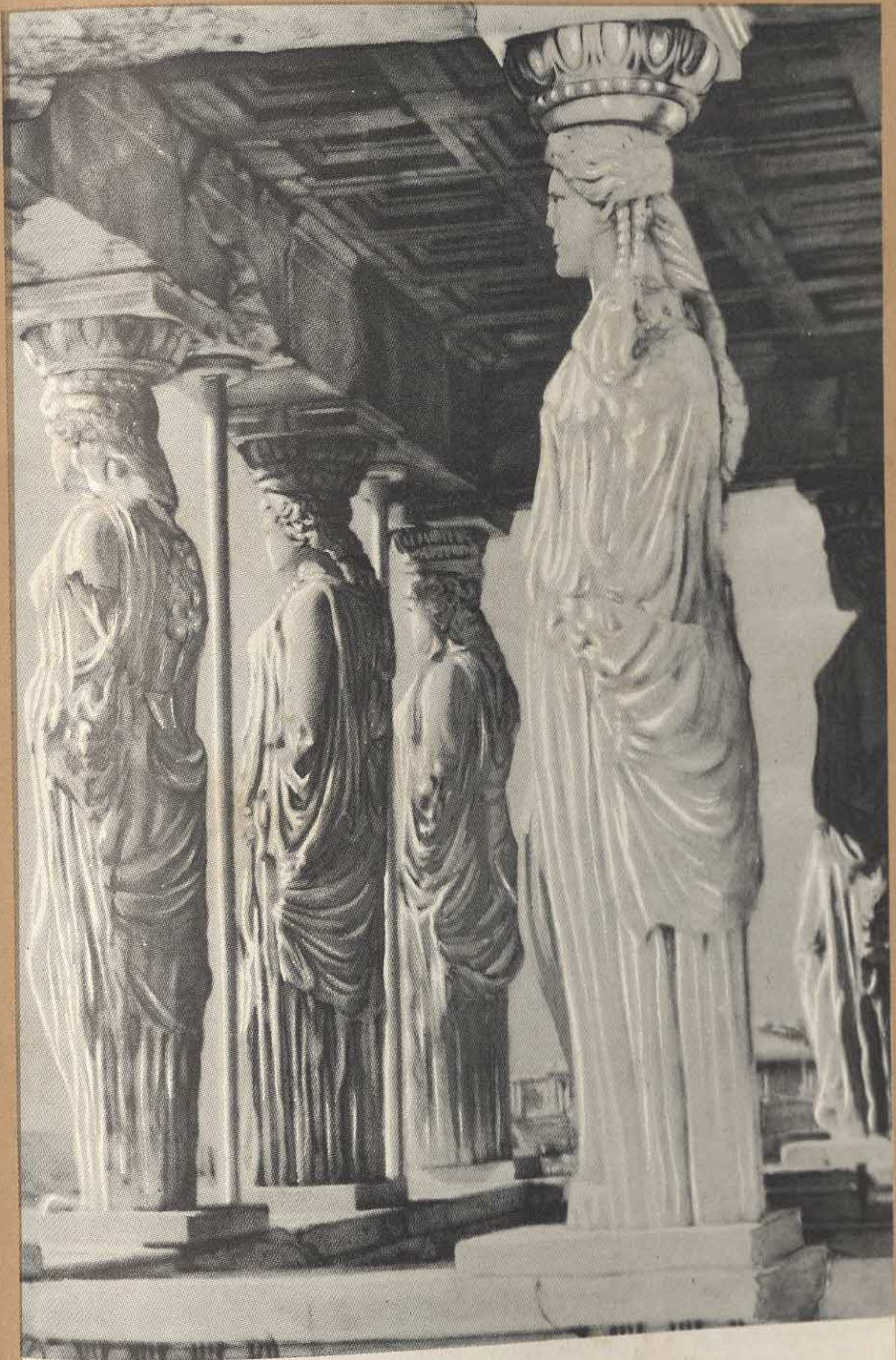
EP'IC. The stories of the great deeds of the heroes are often told in epic poems. Authorities differ as to the exact meaning of *epic,* some claiming that it includes the deeds of historical and humorous characters. All agree, however, that it is a story-telling poem written in a lofty style. The epic differs from the drama in that the author of the epic often speaks in his own person as the story-teller. In contrast to a lyric, the epic deals more with action than with emotion. Some of the greatest epic poems are Homer's *Iliad* and *Odyssey,* the Anglo-Saxon poem *Beowulf,* the German *Story of the Nibelungs,* the French *Song of Roland,* and Dante's *Divine Comedy* (Italian).

EPIDER'MIS. See Skin.

EPIPHYTES, *ep' i fites.* See Air Plants.

EPISCOPAL, *e pis'ko pal,* **CHURCH, or PROTESTANT EPISCOPAL CHURCH.** A sister to the Church of England, the Episcopal Church in the United States maintains the traditional faith, rites, and ceremonies of the parent organization. The history of the organization in America dates from 1579, when the first prayer-book service was conducted near the present site of San Francisco, by the chaplain of the *Golden Hind,* flagship of Sir Francis Drake. Regular services were conducted in 1607 in the Jamestown, Va., settlement, home of the first permanent Episcopalian church in America. The first bishop in America was consecrated in 1784. During the growth of the colonies, the Church gradually gained in influence until by 1789 it had become independent of the English Church and had adopted its own constitution.

The government is vested in a general convention which meets every three years. It is composed of a House of Bishops and



MARBLE GRECIAN MAIDENS FORM A FAMOUS COLONNADE

The porch of the Erectheum on the Acropolis at Athens has the finest examples of *caryatids* in the world. The pillars are really beautiful statues of women.

a House of Clerical and Lay Deputies. The latter group is made up of four clergymen and four laymen from each diocese, which is under a bishop. There are six religious orders for men and fifteen for women. There are over 2,000,000 communicants in the United States.

EQUATOR, *e kwa′ tur.* Around the earth from east to west runs an imaginary line, the equator. It is named from the Latin word meaning *equalizer,* for it lies equally distant from the two Poles. Furthermore, only places located upon it always have equal days and nights, twelve hours each. The equator is the line from which we measure latitude.

Though we think of the region of the equator as being extremely warm, some places a little to the north or south have a higher average temperature, so that a line joining them does not exactly coincide with the *geographic* equator. Such a line is the heat, or *thermal,* equator. It moves northward and southward with the seasons, being north in the northern summer.

There is still another kind of equator, the *magnetic.* At the north magnetic pole a compass needle tends to stand on end just as though we held it over the end of a magnet; at the south magnetic pole it does likewise, but the opposite end points downward. Somewhere between these two poles the compass needle is drawn equally by the two, and, therefore, is in perfect balance, neither end dipping. It is then said to be on the magnetic equator, a line which again does not quite coincide with the geographic equator, being more irregular. See LATITUDE; LONGITUDE AND TIME.

EQUINOX, *e′kwi noks.* The equinox is the time of the year when days and nights are of equal length over the whole earth. This happens but twice a year—on or about March 21 and September 23. On the first date in the Northern Hemisphere it is usually called the *vernal*, or spring, equinox; on the second date, the *autumnal* equinox.

Upon these two dates the vertical rays of the sun are on the equator, while the other rays reach to either Pole. As a result, every parallel of latitude will be half in light, half in darkness. As the earth rotates, every place will be within the lighted area for half the period of rotation (that is, twelve hours); and for the remainder of the rotation period, every place will be on the dark side.

Many people believe that the autumnal equinox is a period of storms, but the records of the Weather Bureau do not show this to be the case.

ERECTHEUM, *er ek′ the um.* Near the Parthenon on the Acropolis stand the ruins of the Erectheum, the temple of the guardian deities of Athens. Built in the fifth century B. C., it is the best preserved and most perfect example of Ionic architecture. The Erectheum was a large rectangular structure, seventy-four by thirty-seven feet, with three porticoes. The south portico had, in place of columns, six beautifully carved feminine figures, called *Caryatids,* which supported the entablature. The temple was named after Erectheus, mythical founder of Athens. It contained an altar dedicated to him and to Poseidon. See ACROPOLIS.

ERICSON, *air′ik sun,* LEIF. Proud Norwegians, descendants of the ancient vikings, have always claimed that Leif, the son of Eric the Red, was the first white man to set foot on American soil. According to legends and historical data left by these hardy navigators, Leif accidentally landed somewhere in North America in the year 1000, nearly 500 years before Columbus made his famed voyage.

The story goes that about fifteen years after Eric settled in Greenland, Leif told him he would like to visit their Mother Country, Norway, which he had never seen. Accordingly, Leif set sail, stopped at Iceland, the Faroes, and the Shetland Islands, and reached Norway in the year 999. There he spent the winter at the court of King Olaf, who requested him to return to Greenland to introduce Christianity among the settlers.

On Leif's return voyage, his ships were

LEIF ERICSON APPROACHES THE COAST OF VINLAND
Bold Leif and his Norsemen crossed the Atlantic centuries before Christopher Columbus.

blown out of their course, and after many days of sailing southward, he landed on a far more beautiful land than either Iceland or Greenland. Because grapes were found there, he called it Vinland. It has since been identified as the eastern coast of North America, the exact location being unknown.

Leif and his men are said to have stayed in Vinland for some time, and then to have gone back to Greenland. Leif never saw Vinland again, although another party of vikings is supposed to have attempted a settlement there two years later. Because he was the son of Eric, Leif bore the name Ericson. He was also called Leif, the Lucky.

ERICSSON, JOHN (1803-1889). A well-known engineer and inventor of the nineteenth century, John Ericsson was born in Sweden. He was for a time a member of the Swedish army, which he left when he moved to London in 1826. Later he moved to New York. He is remembered especially for his construction of the *Monitor,* the famous steel-turreted fighting ship of the American Civil War. The battle between this ship and the *Merrimac* marked the end of wooden ships in naval warfare. Other important inventions by Ericsson are the caloric engine and the screw propeller.

ER'IC THE RED (about 950-1000). Long before Columbus crossed the Atlantic Ocean, the hardy vikings of Norway were sailing the stormy stretches of the northern seas. Among these vikings was a huge, towering, red-haired and red-bearded man named Eric the Red. He left his homeland in his youth and went to Iceland, where many other freedom-loving vikings had settled. But there he was unable to live peaceably with his fellowmen, for he had a quarrelsome nature and is said to have killed a man.

Banished from Iceland, Eric decided to sail west to a land which another viking named Gunniborn had found a century previous. He set sail in a small dragon-like ship propelled by sail and oars, and finally, after many days, reached the shores of the new land, in the year 984.

Even though Eric and his men found little vegetation, except along the shore, they named the country Greenland, hoping to entice settlers. After spending a winter

Joseph Boggs Beale, Modern Enterprises, Phila., Pa.

ON TO THE GREAT LAKES!

The Erie Canal provided a shipping route which extended from New York City to Lake Erie.

there, Eric went back to Iceland, and persuaded a number of colonists to return to Greenland with him. His son, Leif Ericson, is the traditional discoverer of the North American continent. See Ericson, Leif.

ERIE, Lake. An important link in the chain of the Great Lakes, Lake Erie is next to the smallest of the group, and is the shallowest. Lying between Lake Huron and Lake Ontario, Lake Erie forms a part of the northern boundaries of Pennsylvania and Ohio and the western boundary of New York. On the Canadian side of the lake there are no important cities, but Toledo, Sandusky, and Cleveland in Ohio, Erie in Pennsylvania, and Buffalo in New York are commercially important.

With an area of 9,940 square miles, Lake Erie lies 573 feet above sea level. Slightly more than half its area belongs to Canada. The lake is about 240 miles long and has a maximum width of fifty-seven miles. Traffic at the western end of the lake passes through the Detroit River to reach Lake Saint Clair, a rise of only eight feet. But at the eastern end, the waters of Lake Erie are 326 feet higher than Lake Ontario. Water transportation is possible between lakes Erie and Ontario through the Welland Canal, the locks of which make possible the raising and lowering of boats. Because of its shallowness, Lake Erie is churned into raging seas during a high wind. See Great Lakes, The.

ERIE CANAL. For many years, America's greatest commercial highway was the Erie Canal, an artificial waterway extending 363 miles across the state of New York, from Buffalo to Troy and Albany. Important to nineteenth-century trade, the canal also was the main pathway of westward-bound settlers. The easy transportation it afforded aided in the development of upper New York state and the Middle West. The historic Erie Canal is now a part of the New York State Barge Canal, and the reader is referred to the article under that title.

The Erie Canal was urged as early as 1791, when a preliminary survey for the project was made. New York petitioned Congress to undertake the project, but it was not until 1817, when DeWitt Clinton became governor of New York, that the work was started. Eight years later, in 1825, the canal was finished at a cost of over $7,143,000. It provided a water thoroughfare for boats eighty feet long and fifteen feet wide. Immediately the canal became crowded with craft, and within ten years of its completion, it was inadequate for its heavy traffic. During the next few decades, the Erie Canal was widened and deepened to accommodate ships of considerably greater dimensions. In 1903, a bond issue of $101,000,000 was ratified for additional improvements and reconstruction of the canal, together with the construction of other waterways included in the New York State Barge Canal.

During the days of its greatest usefulness, the Erie Canal provided a colorful setting for a brilliant era in American life. Towns grew up along its shores, thriving on the trade brought by the canal. The barges which moved slowly up and down carried gaily attired passengers who whiled away the long hours on the flat-decked boats by playing cards and discussing trade, politics, and the slavery question. The women, costumed in crinoline skirts and charming bonnets, carried parasols to protect themselves from the hot sun. The men wore beaver hats and tight-fitting trousers.

As the boats approached each landing, there was usually a crowd on the shore, cheering and welcoming them on their journey. The busy life along the canal was typical of the young, energetic country which was pushing its way westward to wealth and adventure.

But the importance of the canal has greatly diminished in modern times. Although it is still used, it has had heavy competition from the faster railroads which grew up along its shores. The building of smooth, hard roads and the swift progress of the automobile also have taken considerable traffic away from the canal, and today much of the freight that formerly would be shipped by barge from Buffalo to New York is now hauled by truck and train. See CLINTON, DEWITT.

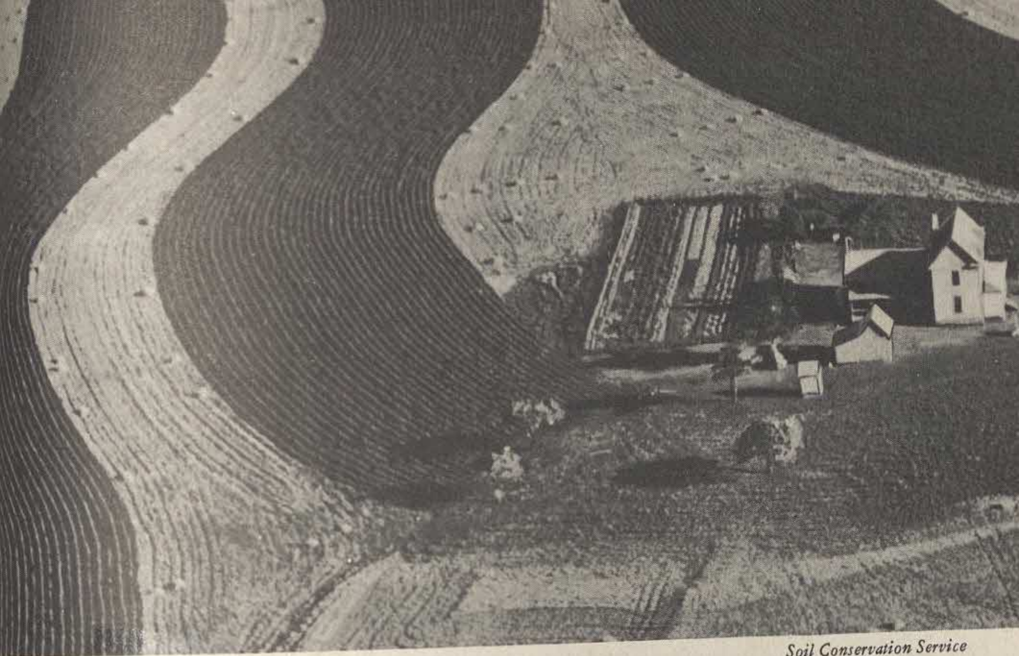
ERITREA, *air e tra' ah.* This land along the northeast shore of Africa, bordering on the Red Sea, was Italy's key to the conquest of Ethiopia in 1935 and 1936. Prior to this time it was not considered of great importance. In 1870 Assab and a strip of territory around it were purchased by an Italian company for a coaling station. Later it was declared an Italian possession. Step by step more territory was added, and the new colony was named Eritrea by the government, in memory of the "Mare Erythraeum" — the Roman name for the Red Sea. In 1936 Eritrea became a part of Italian East Africa; but in 1941, during World War II, British troops captured it, and it remained under British administration until 1952. Then, in accordance with a United Nations' decision, it became an autonomous state, federated with Ethiopia.

BLACK-TAILED ERMINE

Eritrea has an area of about 48,350 square miles and a population of about 1,000,000. On the low, hot coast is Massaua, the chief port, with the best harbor on the Red Sea. At Massaua and Assab many workers are employed in the salt industry and the pearl fisheries. Fish meal, pearls, mother-of-pearl, hides, and skins are the chief exports. But most Eritreans are small farmers or herdsmen, who drive their sheep, goats, and humpbacked cattle back and forth between the hot, dry lowlands and Eritrea's cooler, semi-arid uplands

EROSION — SCULPTOR AND DESTROYER
The erosion of wind and water sculpted the fantastic formations that attract tourists to Bryce Canyon, Utah (above). But water, wind, and sun can also erode and destroy productive farmland (right). Man fights erosion in a variety of ways. Grasses may be planted to anchor drifting and blowing soil (below).

Union Pacific Railroad Photo; U.S.D.A.



Soil Conservation Service

A FARM FORTIFIES ITSELF AGAINST EROSION

Terracing, strip cropping, and contour cultivating conserve the soil and retain moisture.

of the interior. Inland, coffee, tobacco, sesame, barley, corn, figs, and dates are raised, and there are a few gold mines and some oil.

Asmara, the capital, is located on the inland plateau. It has some small factories and an airport and is connected with Massaua and other towns by a railroad and a number of highways. See ETHIOPIA.

ERMINE, *ur′min,* **or STOAT,** *stote.* Long the badge of royalty and used in regal robes of state, ermine is the name given to the fur of the weasel whose rich, soft coat of reddish brown turns white in winter. The colder the weather, the whiter the coat becomes. The tip of the tail of the small animal is always black, accounting for the black fleck seen in garments and trimmings of ermine. For beauty, ermine is unsurpassed, and it is one of the most valuable of furs. The best skins come from Siberia, Northern Europe, and Northern Canada.

EROSION, *e ro′zhun.* One of the greatest enemies of the farmer today is erosion, the wearing down and carrying away of the soil by the action of rain, running water, waves, ice, and wind.

Erosion on the Farm. Two common types of farm erosion are *gullying* and *sheet erosion.* Gullying scars the fields with deep ditches and eventually ruins them for further agriculture. It is usually brought about by a heavy rainfall which starts streams running across the fields, washing out gullies. In time, the gullies grow too deep to be crossed by farm machinery.

Sheet erosion is just as ruinous to farm land as is gullying. Heavy rains wash away sheets of the valuable topsoil where land is loosely cultivated. *Dust storms* have much the same effect, picking up the loose topsoil and carrying it for hundreds of miles.

How Erosion Is Prevented. All sloping land is likely to erode during heavy rains. Farmers have learned to plant the most sloping areas in grass, hay, or small grains, which tend to hold the earth together. A common practice is *contour farming,* in which crops are planted across the slopes rather than following them. When the rows are cultivated, the ridges tend to prevent the downward flow of water, causing more of it to sink into the ground. Another method is *terracing.* Terraces are built by plowing furrows across the slopes, forming a ridge which tends to hold the water descending from above. *Mangum terraces* are built to lead water off the fields gradually, preventing the washing away of the soil.

Other Types of Erosion. Along the seashore, waves wash away the rocks, sand, and gravel, often leaving great holes in the beach and causing a rugged, unsightly shore line.

Ice erosion occurs when water, seeping into the crevices of a rock, freezes, and, by expanding, breaks away pieces of the stone. It was by such erosion that much of the North American soil was formed thousands of years ago when a great glacier covered the land (see GLACIERS).

Along even small streams, the soil is continually being washed away, the action of the water causing the banks to crumble and pushing back the shore line. Along large streams the damage done by water erosion may be tremendous. An interesting example of erosion is in Arizona, where the Colorado River has cut the river bed fully a mile deep into the rock, forming the Grand Canyon.

Besides the dust storms, another type of air erosion occurs by the action of oxygen, carbon dioxide, water vapor, and other substances in the air which decompose rocks and form new compounds which are carried away by the wind.

E'SAU. One of the familiar Bible narratives is the story of Esau, the eldest son of Isaac and Rebekah and the twin brother of Jacob. How Esau lost his birthright through the craft of his mother and brother is told in this work under BIBLE STORIES.

ESKIMO. Far to the north in frigid lands of snow and bitter winds live the Eskimos, American Indians of the Arctic zone. Eskimos have been living under these harsh conditions for about 10,000 years. At one time they numbered about 450,000. Their present population is less than 50,000. Disease and new ways of life introduced by outsiders account for the drop in population. Only a few live in Siberia; the rest are found in Alaska, Greenland, and Canada.

Ewing Galloway

BREATH MEANS DEATH

Eskimos hunt their game through cracks in the ice where swimming mammals must come to get air.

Short and somewhat stocky, Eskimos have yellowish skin, flat noses, wide oval faces, high cheek bones, and straight black hair. They are honest, hardworking, and skilled at making the most of the scanty resources of their homelands.

Some Eskimos still live as their forefathers did, but many who have come into contact with the white man and his goods live and dress much as do whites in the Arctic. The United States Government in Alaska, the Danish government in Greenland, and the Canadian Government in northern Canada work through various agencies to educate the Eskimo and to safeguard his health and general welfare.

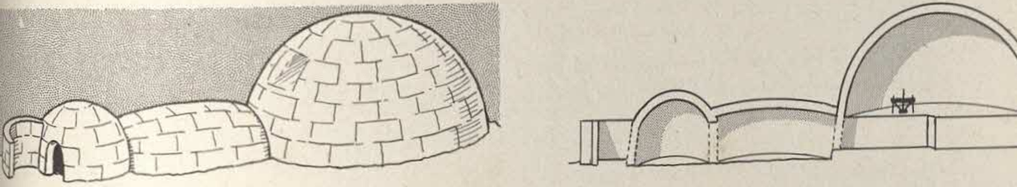
Work. Formerly, hunting and fishing were the only occupations of the Eskimos. Later, many became traders, exchanging their extra furs, whalebone, and eider

Richard Harrington

HIS TRAPPINGS ARE HEAT TRAPS

Dressed in his fur clothes, an Eskimo is able to nap comfortably in sub-zero temperatures. Designed on the basis that heat rises and can be trapped, much as the heat rising from an open fire, his clothing is loose at the bottom and closed at the top. Cold air entering at the bottom serves to hold in air warmed by his body.

HEAT ENGINEERING IN SUB-ZERO COLD

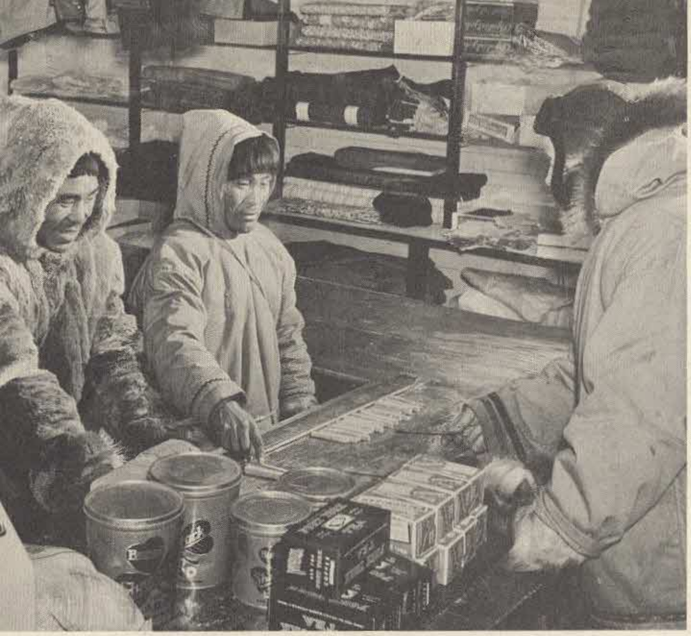


COZY COMFORT IN BEARSKIN OR BARE SKIN

The Eskimo's snowhouse is made of snow blocks that insulate against freezing temperatures and the floor of the living quarters is higher than the entrance. Cold air coming in forces warmer air upward to the second level. In her whalebone stove the Eskimo woman burns seal oil with a single moss wick. It is the only heat but an unclothed baby is safely warm.

National Film Board of Canada

Fritz Goro—LIFE Magazine, © Time Inc.



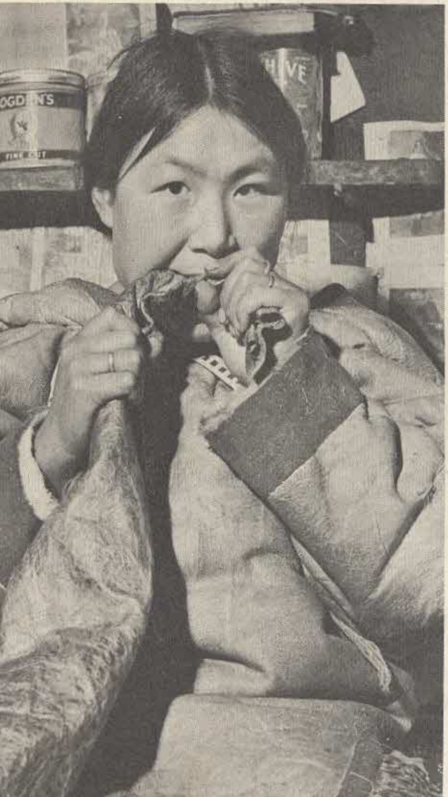
At the trading post, the Eskimo's equivalent of the supermarket, skins are traded for merchandise such as lard, tea, and clothing. The Eskimo lays out a row of sticks, each representing a "skin," equal to about fifty cents in trade. A silver fox is worth about thirty skins. As purchases are made, the sticks are moved aside so the Eskimo knows exactly how much he has spent and how much he has left to spend.

National Film Board of Canada

A STRANGE BLEND OF PRIMITIVE AND MODERN WAYS

Though Eskimo women sometimes wear modern dresses and sweaters, they turn to their traditional fur clothes for comfort in bitter cold. Before clothing is made from pelts, the skins are chewed by the women to make them soft and pliable. Then, within the mother's generously roomy shirt and hood, an Eskimo baby can be warm and snug.

Richard Harrington



National Film Board of Canada

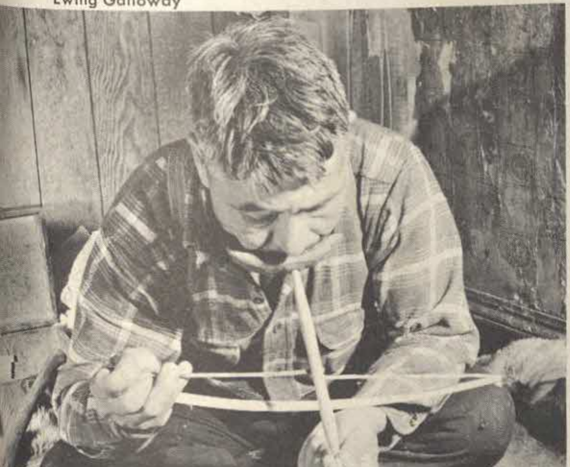
The Eskimo leads a rather nomadic existence, frequently moving to follow the game he uses for food, clothing, and barter. Even modern equipment such as the sewing machine must therefore be portable. There are no tables and no source of power, so the machine is placed on fur rugs on the ground and operated by hand power.

National Film Board of Canada

HELPS THE ESKIMO CONQUER HIS HARSH ENVIRONMENT

With simple equipment, some ancient and some modern, the Eskimos are able to create beautiful art objects, jewelry, toys, tools, and weapons. In carving ivory for bracelet making, the Eskimo, below left, uses a drill pointed with a tempered nail and a thong of walrus hide as a bow string. A back-and-forth motion of the bow causes the drill to turn. To produce carvings in soapstone and ivory, steel rasps are now often used instead of the traditional Eskimo tools.

Ewing Galloway



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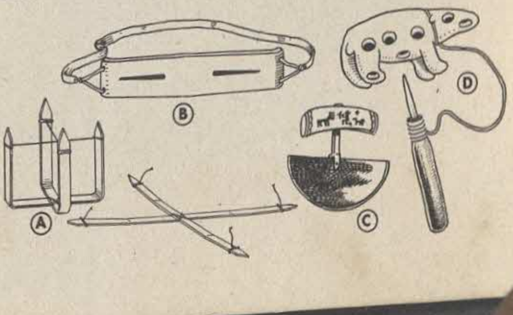


A Flexible wolf killer, swallowed in the wolf's food, springs open in its stomach.
B Wood or leather eye shade for protection against snow glare.
C Knife with curved blade used for carving, chopping, and skinning.
D Child's toy to toss up and catch by a hole with the pegged handle.

down for the goods of the white men's Arctic trading posts. But the guns they acquired killed off so many animals that the Eskimo hunters often found it hard to get enough food and furs for their own families. To solve this problem in Alaska, the United States Government brought in reindeer and taught the Eskimos to herd them as a source of meat and hides. Other Alaskan Eskimos now work in American canneries and on construction projects.

Government. Among themselves, the Eskimos have found little need for government. Sometimes they choose a wise man to serve as village leader or select the best hunter to act as chief on a long hunting trip. Generally, though, each family governs itself.

Food. Away from the white man, Eskimos live chiefly on raw meat, fish, fats, and oils. Among the sea animals eaten are seals, walruses, and whales, while the land provides caribou, musk ox, fox, bear, and hare. The chief hunting weapon is the *harpoon,* a spear with a line attached. A few berries and shoots found in summer are the only plant food.

Clothing. The native costume of trousers, jackets, and boots, worn by men, women, and children alike, is made from the furs and skins of animals. Fastened to the jackets are warm fur hoods called *parkas.* The women chew the skins until they are soft and use sinews for thread and needles of bone or ivory. Many Eskimos now wear "store-bought" garments.

Houses. The Eskimo summer home is a tent of skins, supported by driftwood or whale ribs. In winter, houses of stones or logs are built and then covered with earth or snow. In areas where no other building materials are available, blocks of ice and snow are used to construct dome-shaped *igloos.* Skins curtain the low entrance tunnel to shut out the cold, and a bowl of oil, with a wick of dried moss, serves as a lamp. Igloos are now seldom used except as shelters during long hunting trips.

Transportation. Sleds drawn by dogs are still the chief means of land transportation for American Eskimos, although in some areas the reindeer is a beast of burden. For water travel the Eskimos have the *kayak,* made by stretching skins over a frame of wood or bone and used by a single hunter; and the *umiak,* a large, open boat used to carry whole families.

Customs. In many Eskimo communities where everyone shares in the spoils of the hunt, quarrels may be settled by having the opponents make fun of each other in song and dance until they and the onlookers are laughing. The Eskimos also stage many feasts, at which they sing about, or act out, their hunting exploits, dance to the music of their drums and rattles, take part in athletic contests, and observe the rituals of their medicine men. The ivory, wood, and bone carvings, woven baskets, and beautifully decorated garments made by Eskimos are proof of their artistic abilities. See ALASKA; ARCTIC OCEAN AND LANDS; GREENLAND; REINDEER; ROYAL CANADIAN MOUNTED POLICE.

ESPERANTO, *es per ahn' toh.* A language which everyone could read and speak was the goal of Dr. L. I. Zamenhof of Warsaw, Poland. His suggestions were first published in 1887 under the assumed name of *Dr. Esperanto,* from which the artificial language gets its name.

An international language would simplify the printing of books and permit a broader spread of world culture by eliminating the expense of translation from one language to another. It is felt by many people that a universal language would bring them closer together by making them understand each other better, and thus lead to a more peaceful world.

Such a language, however, conflicts with national pride and customs which people cherish. To adopt an international language completely would necessitate the relearning of speech by all peoples and the reprinting of books and other records.

Of the many attempts to produce an international tongue, as a substitute for the wide variety of languages and dialects in the world, the system of Esperanto seems to offer the most possibilities. The vocabulary is built upon root words that are commonest to most European languages. The grammar is regular and simple, with suffixes and prefixes playing a prominent part. For example, *bona* means *good; malbona, bad. Fermi* means *close; malfermi, open.* The suffix *in* is feminine. While *knabo* means *boy, knabino* means *girl.*

Although several books have been printed in Esperanto, it has not been widely accepted. Soviet Russia, however, has recognized the importance of the linguist and has honored his efforts with a special postage stamp. Other international languages competing with Esperanto are Volapük, Ido, and Neutral.

ES'SAY. Poetry, drama, fiction—all of these are examples of man's ability to write in different forms and to express his ideas of life and people. But none of these forms necessarily reveals the writer's ideas on a certain subject. That type of writing is reserved for the essay, a method of composition that has brought many men to the fore in the world of letters.

An essay may be on any subject and it may be written in any one of a number of styles. It may include description of a vacation trip, or an impression of the latest models in automobiles. It may be a discourse on the beauty of a famous painting, or a criticism of a recent law passed by the city council. An essay can be in the form of a simple, descriptive narrative, a debate, or a series of dialogues. It may be serious or humorous.

One of the most common forms of essays found in the everyday world is the newspaper editorial. In it appears the opinion of the newspaper on a certain subject, praising or condemning some action, or perhaps explaining it; there may be a request that some action be taken. Newspapers also contain music, drama, and book criticisms which are really essays, since they are expressions of opinion. Otherwise they are merely expositions and not essays.

In writing an essay, various methods of approaching the subject are used. A writer may begin by a quotation, or by describing an incident. Or he may simply state his opinion, and then add his reasons. In any event, the writer of an essay, especially a lengthy one, should have his material well organized, and should write in such a manner that he will be understood.

Two of the best-known essayists in history were Michel de Montaigne, a Frenchman, and Charles Lamb, an Englishman. Both of these authors wrote in an informal and clear style, and their works are read widely today. Other well-known writers of essays were Francis Bacon, Ralph Waldo Emerson, Henry Thoreau, Joseph Addison, Robert Stevenson, Washington Irving, and Thomas Carlyle.

For additional information, consult articles under the following headings:

Addison, Joseph
Bacon, Francis
Burroughs, John
Carlyle, Thomas
Emerson, Ralph W.
Goldsmith, Oliver
Holmes, Oliver W.
Howells, William D.
Irving, Washington
Lamb, Charles
Lowell, James
Macaulay, Thomas
Montaigne, Michel de
Ruskin, John
Shaw, George Bernard
Stevenson, Robert L.

ESTATE'. When a person dies, the property he leaves is called his estate. The term has come down to us from feudal times, when it meant the interest that a landholder had in his land. The medieval kings granted sections of land to vassal lords, in return for certain services.

Several classes of estates were granted, and, in general, the same groupings exist in law today. One class, known as *freeholds,* includes three divisions. The first, *fee simple,* is absolute ownership; the second, *fee tail,* requires the possessor to dispose of the estate to his children; and the third, the *life estate,* allows the holder the right to the estate during his lifetime only.

An estate may also mean a group of people with special duties or privileges. In medieval times, the estates usually comprised the clergy, the nobility, and the common people. In modern days, the term *fourth estate* is applied to journalism; thus, a newspaper reporter may be termed "a member of the fourth estate."

ESTHER, *est'ur*. The last historical book in the Old Testament, the *Book of Esther* tells the story of a Jewish maiden who, although a queen of Persia, risked her life to save her people from a massacre. The Feast of Purim, celebrated by the Jews, commemorates the deliverance of Esther's people. The book is said to have been written about 450 years before the birth of Christ, and is unusual in that the word *God* is not mentioned once. See BIBLE.

ESTONIA. One of the Baltic group of states of North Central Europe, Estonia is bounded on the north by the Gulf of Finland, on the west by the Baltic Sea, on the south by Latvia, and on the east by the U.S.S.R. Including three large islands in the Baltic Sea, Estonia's area is about 18,300 square miles. Since 1940, Estonia has been an autonomous state in the Soviet Union.

The country is mainly a flat plateau, marked by numerous lakes and marshes. About one fifth of the land is thickly wooded. The country is well suited to agriculture, and nearly three fourths of the people are engaged in farming and dairying. Others are occupied in Estonia's rapidly growing industries: lumbering, papermaking, and the refining of oil shale. Butter, timber, and paper products are the chief exports; the principal imports are cotton, sugar, wool, and steel.

Estonia, once a part of Russia, gained its independence in 1918. In 1939, however, it was forced to give Russia naval and air bases and in 1940 became a part of Soviet Russia. Many Estonians of German descent were forced to migrate to the German Reich. Germany occupied Estonia from 1941 to 1944. Its population is about 1,120,000; Tallinn is its capital and largest city. See GERMANY; RUSSIA.

ES'TUARY. Where a river flows into a large body of water, a very broad mouth, or estuary, may form. It is really a valley which has been submerged and eaten away by constant wear of the waves and the weather. Estuaries are usually shallow, being constantly filled by soil and debris from the upper channels of rivers. Sandbars often form, interfering with navigation. The rising and falling tides, if the estuary opens into an ocean, cause the bars to shift so that seamen do not know their location in advance. The Delaware and Chesapeake bays and the mouths of the Thames and the Elbe rivers are examples of estuaries.

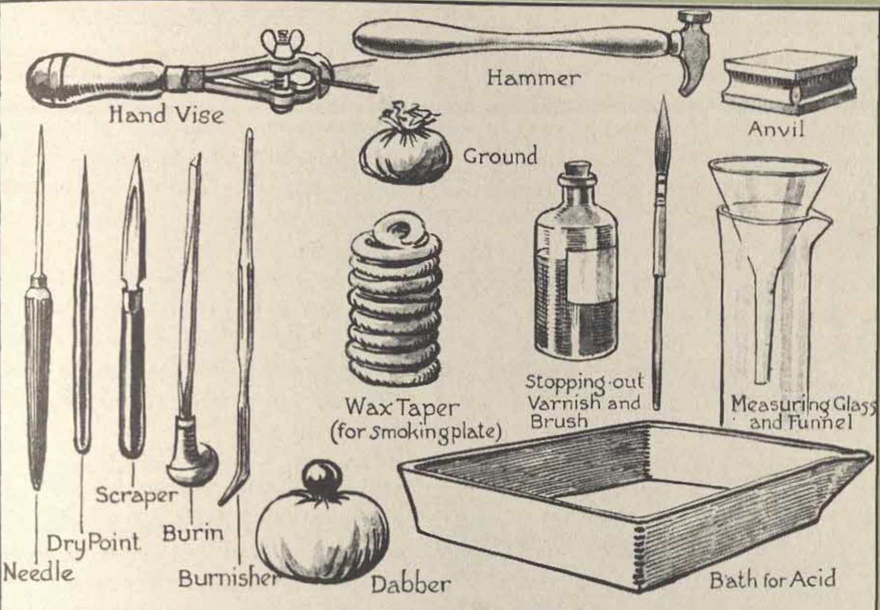
ETCH'ING. When nitric acid is dropped on an ordinary penny, it eats, or *etches,* a hole in the copper. Metals, particularly copper and zinc, react easily to acid; this principle is the basis of the art of etching. Beautiful pictures can be made for reproduction by cutting an outline which can be printed on paper. Good etchings are highly prized as works of art and are often framed or used in illustrating books.

The first step in etching consists of cleaning a metal plate and covering it with a substance known as *etching ground* that resists the action of acid. The artist cuts a design through this coating with steel tools called *etching needles.* Then the plate is placed in a weak solution of nitric acid which etches the uncovered areas. Differences in shading are produced by etching parts of the plate in the solution for longer periods than others.

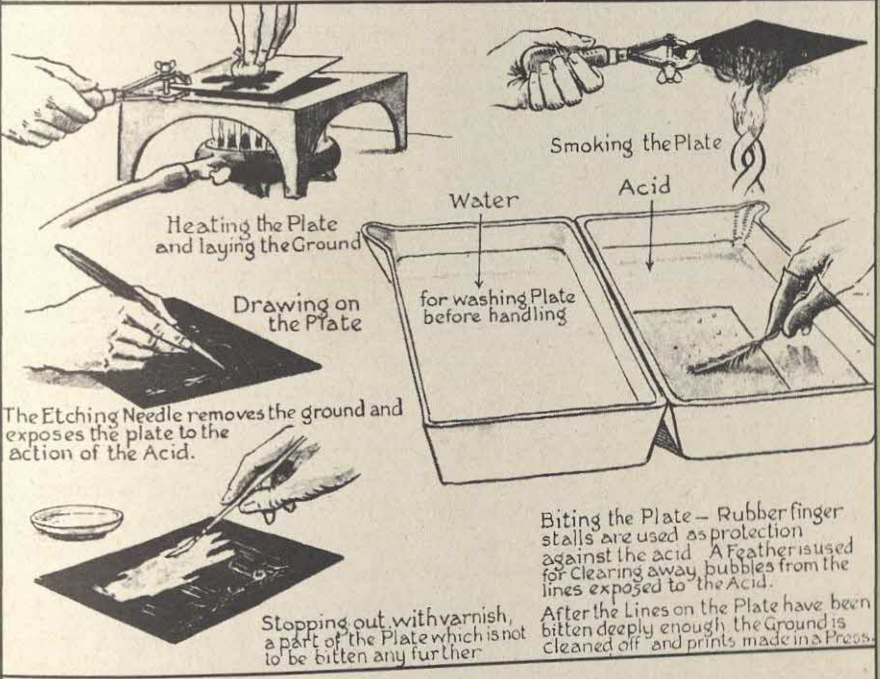
Engraving, another process of making pictures on metal, is done by cutting the metal directly with tools. Some of the finest results are obtained by combining the two methods. See ENGRAVING; ZINC ETCHING.

ETHELWULF, *eth'el woolf* (?-858). Before the Normans conquered England in the eleventh century, the land was divided into several small kingdoms. Ruler over three of these kingdoms, Kent, Essex, and Sussex, was Ethelwulf, who had been given these lands by his father, Egbert.

When Egbert died, in 839, Ethelwulf became king of Wessex, a larger kingdom, and immediately was faced with an invasion by the Danes. After driving out the invaders, Ethelwulf journeyed to Rome; but when he returned he found that his son Ethelbald had seized the throne. Wishing to avoid civil war, Ethelwulf abdicated,



TOOLS USED IN ETCHING


Smoking the Plate
Heating the Plate
and laying the Ground
Water
Acid
for washing Plate
before handling
Drawing on
the Plate
The Etching Needle removes the ground and
exposes the plate to the
action of the Acid.
Biting the Plate – Rubber finger
stalls are used as protection
against the acid. A Feather is used
for Clearing away bubbles from the
lines exposed to the Acid.
After the Lines on the Plate have been
bitten deeply enough the Ground is
cleaned off and prints made in a Press.
Stopping out with varnish,
a part of the Plate which is not
to be bitten any further

MAKING PICTURES WITH ACID AND A COPPER PLATE

Etching requires artistry all through the process, from sketch and preparation of the plate to pulling the proofs or finished prints. Above are the etcher's tools and equipment. The *needle* is the actual drawing tool: *dry point, scraper, burin,* and *burnisher* are used for last touches after the acid has done its work. The *ground*, a substance unaffected by acid, is applied to the plate with the dabber. Then it is smoked so the artist can see his lines clearly. The needle cuts through the ground to the metal, allowing the acid to "eat" the metal lines out. The varnish stops acid action on selected areas.

content to reign again over the three kingdoms given to him by his father.

Ethelwulf's fourth son, Alfred, later was to become one of the greatest kings who ever ruled in England. See ALFRED THE GREAT.

ETHER, *e' thur.* We know that a water wave is transmitted by an up-and-down motion of the water, and that sound and earthquake waves also are transmitted by vibrations in a material medium (see WAVES). It was natural then, when light was shown to be a wave motion, to assume that this motion was due to vibrations of particles of a hypothetical material, which was called the *ether.*

The ether was supposed to fill space everywhere, between stars and even between atoms of matter. To account for the behavior of light waves it had to be rigid and elastic, like a solid, and yet low enough in density to let planets move without friction. But none of the experiments made to determine the earth's motion in space relative to this fixed, rigid ether gave results that agreed with theory. This failure led to the development of Einstein's theory of relativity, in which the notion of an ether is discarded. See EINSTEIN, ALBERT.

Ether is also the common name of the colorless, sweet-smelling liquid which chemists call *ethyl ether.* Made by the action of sulphuric acid on ethyl, or grain, alcohol, it was widely employed as an anesthetic after its first use in operations in the 1840's. Its fumes make a person insensible to pain, and it is safe for use on most patients, excepting those who have kidney disorders, bronchitis, or weak hearts. However, its aftereffects, especially nausea and vomiting, are often so disagreeable that several newer anesthetics are now more widely used.

Ether is used in the making of guncotton, collodion, some plastics, and synthetic fabrics. It is also employed as a solvent for gums, fats, and waxes. A small amount of ether and alcohol injected into the manifold of an automobile will make the motor start quickly in cold weather. See ANESTHETIC; CELLULOSE; ETHYLENE.

ETHIOPIA, *e thih o'pih ah* (formerly ABYSSINIA). Lying inland from the Red Sea and the Gulf of Aden, this ancient, independent country of Northeastern Africa is bordered on the west by the vast marshes of the White Nile Valley. To reach it by land from any other side, one must cross its surrounding deserts and climb upward through the narrow, steep canyons cut by rivers in its mountain-dotted plateaus.

Over twice the size of California, Ethiopia covers some 350,000 square miles and has more than 20,000,000 residents. These are mostly poor people who live much as did their ancestors centuries ago. Most of their houses are cone-shaped mud huts with thatched roofs. The common dress is a long strip of cotton cloth, worn toga-fashion over the shoulder.

All Ethiopia lies within the Torrid Zone and is very near the equator. The regions having an elevation of less than 5,000 feet are very hot the year round; but the heart of the country, the highland from 5,000 to 8,000 feet in elevation, has a mild, pleasant climate and rich soil. It is here that most of the people live and the capital, Addis Ababa, is located. Above 8,000 feet, the climate is too cool for farming, but sheep and goats are grazed.

Most of Ethiopia has abundant rainfall, with torrents falling in the June-to-October wet season. Carried to the main stream of the Nile by the Blue Nile, which rises in North Ethiopia's Lake Tana, this water causes the annual rise of that great river. Farming and herding are the chief occupations. The major crop is coffee. Other farm products include grains, cotton and other fibers, tobacco, sugar cane, oilseeds, and a variety of fruits. Since most of the country is either grassland or too rough for cultivation, livestock-raising is especially important. Millions of cattle, mostly of the humpbacked zebu type, sheep, goats, horses, mules, donkeys, and camels are raised.

Acme.

Ewing Galloway

ETHIOPIA THE PRIMITIVE

Backward, little-known Ethiopia became a center of world attention when it fought against Italian imperial expansion. Above, Ethiopian army camp. Right, a tribal chieftain.

From the mountains and river-bank forests, high-grade timber could be cut, but this natural resource never provided much but firewood until some wood began to be used for making plywood and paper. Mining has also barely begun, with gold and platinum the chief minerals produced. Coal, iron, copper, mica, graphite, and potash are also present. The processing of coffee, the tanning of hides and skins, the milling of oilseeds, flour, sugar, and cotton, and the making of soap, shoes, cement, and fiber goods offer opportunities to Ethiopia for continued industrial development.

Most Ethiopian produce is used at home, but some coffee, grains, cattle hides, goat, sheep, monkey, and leopard skins, beeswax, civet, and butter are exported. Imports include cotton goods and yarns, salt, building materials, and petroleum products. The lack of transportation is largely responsible for the backwardness of the country. Its only railroad, connecting Addis Ababa with the Red Sea port of Djibouti in French Somaliland, was opened in 1917. This road is owned jointly by France and Ethiopia. It is about 486 miles long. Although bridges, motor roads, and air fields are being built, most transport is still by camel in the lower areas and by mules and donkeys in the highlands.

Ham's People. Traditionally, Ethiopia is the Cush of the Old Testament; its people are the descendants of Ham, the son of Noah. Because its natives are such a mixture of peoples — chiefly Hamites and Semites, further mixed with Greeks, Arabs, Negroes, and others — the early Arab invaders named the country Abyssinia, meaning *mixed* in Arabic. Ethiopia, its older name, which was readopted in 1923, probably comes from the Greek for *burned faces,* referring to the dark skins of its people.

The official language is called *Amharic.* Many Ethiopians are Coptic Christians or Moslems, but many others are pagans. Nearly all are illiterate, though primary schools and a few higher ones have been opened. In 1950 a university college was established in Addis Ababa.

History. Ethiopians believe that theirs was the realm of the Queen of Sheba and that their present ruler is descended from her and King Solomon. Some also claim that the Biblical Ark of the Covenant is still hidden in the holy city of Aksum. Little is known of Ethiopia's early history, however, except that some of its people became Christians in the 330's, that the Arab invaders of the 600's tried unsuccessfully to wipe out their Christianity, and that Ethiopia then remained isolated for nearly a thousand years.

An armed conflict with Britain ended in 1868 with the suicide of Ethiopia's emperor. After that, the country's chief trouble was with Italy, which it defeated at Adowa in 1896. In 1935, however, Ethiopia's brave warriors, with their old-fashioned rifles, were no match for the Italians' planes. Conquered within six months, Ethiopia was combined with Eritrea and Somaliland to form the colony of Italian East Africa.

In 1941, British troops helped Ethiopia's emperor, Haile Selassie I, to regain his throne and country's independence. Since then, Ethiopia has been working hard to modernize and expand its transportation, communications, education, health services, and industries.

Ethiopia joined the League of Nations in 1923 and is a charter member of the United Nations. In 1952 it was federated with Eritrea. It thus gained access to the Red Sea. It handles Eritrea's currency, foreign affairs, and defense. Haile Selassie gave the people their first constitution in 1931. It provided for a parliament and system of courts. The new constitution of 1955 provided for freedom of speech and press, and universal suffrage for men and women above the age of 21. In 1959, the Emperor secured loans of money from the Soviet Union and other Communist countries for technical and economic improvements. See ADDIS ABABA; ERITREA; NILE.

ETHNOLOGY, *eth nol' o ji.* Ethnology is the study of the origin and development of the races and families of men. It is a branch of the broader science, anthropology. Comparisons of different tribes and peoples and the contrasts between different periods of man's development reveal man's progress and the effect of social customs.

Careful studies of American Indian tribes have been made relative to their past and present cultures. Particular attention has been given to the relation between primitive and modern customs. Similar studies of other races have been made as to their ceremonies, religious beliefs, customs, and works of art. A broader view of individual and universal life is thus obtained.

Ethnography, a branch of ethnology, describes the races of men and traces their geographic distribution. It is primarily concerned with races as they are found today. In this field, the study of the American Indian has been particularly thorough.

Consult the following articles for additional information:

Anthropology
Babylonia
Cave Dwellers
Civilization
Cliff Dwellers
Indians, American

ETHYLENE, *eth' i leen.* A constituent of illuminating gas, the colorless gas ethylene is also called *ethene* by chemists. It is a hydrocarbon which has come into prominence as an anesthetic.

Dr. A. B. Luckhardt and J. B. Carter of the University of Chicago brought ethylene to the favorable consideration of the medical profession in 1923, after careful investigation in clinics. It is now in general use in surgery and dentistry as a general anesthetic, and also as an analgesic (soothing agent) in minor operations. It renders patients unconscious more rapidly than ether and produces no objectionable aftereffects.

ET'NA, or AETNA, *et'na.* The greatest volcano in Europe and one of the most active in the world, Mount Etna, with its constantly smoking cones, is an awesome sight to a visitor of Sicily. The natives have learned through tragic experiences that its

courtesy Canadian Pacific Ltd.

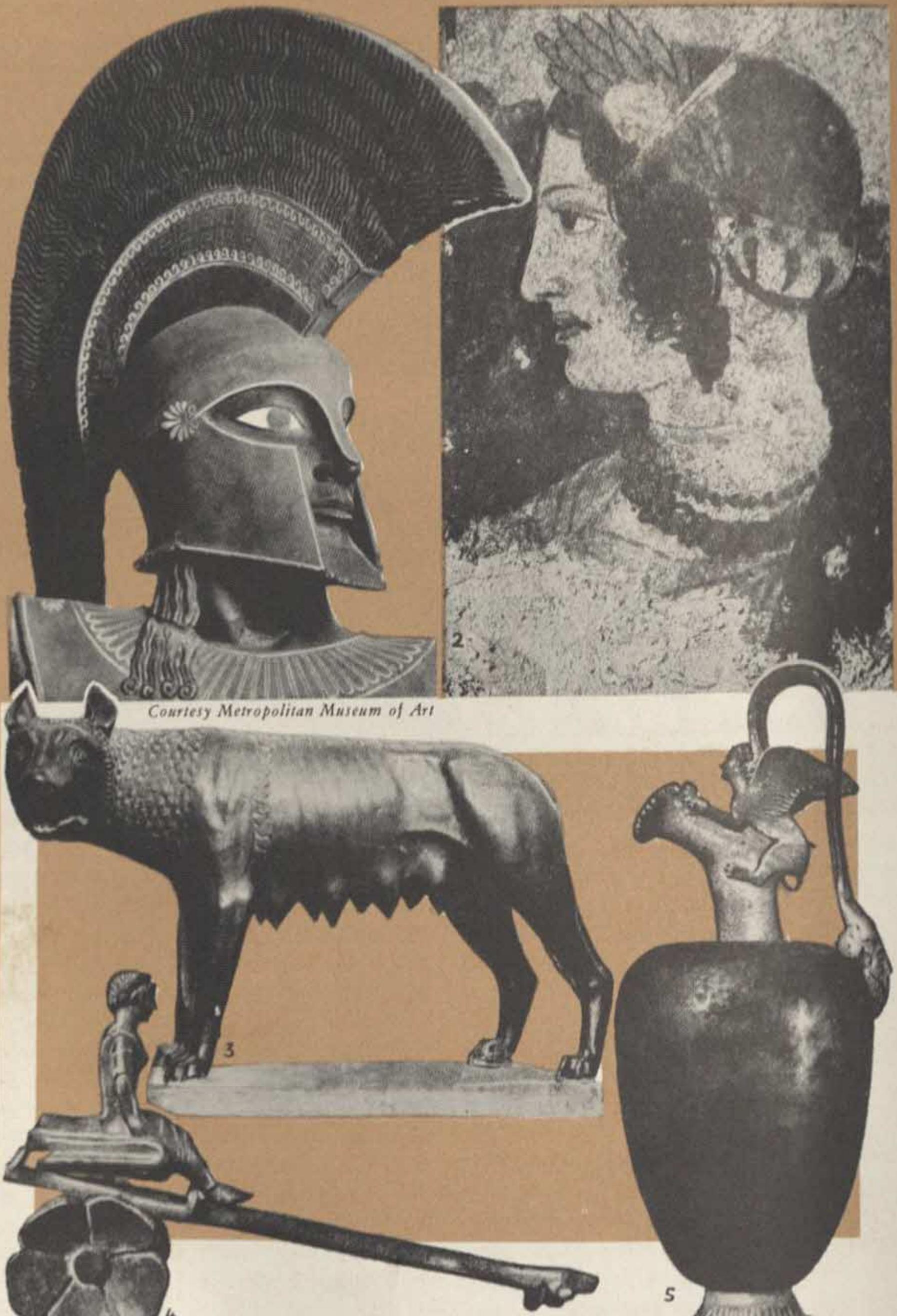
ETHNOLOGY STUDIES THE RACES OF THE EARTH
And finds that American Indians (left) are distant relatives of the Mongolians (right).

gentle rumblings cannot be trusted. Time and again, with little warning, it has spouted forth thousands of tons of molten lava, destroying homes, orchards, and olive groves, and burying the folk who live in the numerous towns on its lower slopes. Frequently its eruptions have been accompanied by earthquakes. The top, 10,750 feet above the sea, is always white with snow, in strange contrast to its seething heart.

Etna's days of terror have been numerous. In 1169 the city of Catania was the victim of an eruption, and 15,000 of its inhabitants were buried. Five hundred years later, lava poured forth for forty days, and 20,000 persons are thought to have lost their lives. Again, in 1693, came an earthquake and eruption bringing death to 60,000. Minor outbreaks occurred in 1865, 1879, 1886, and 1911. Then, in 1928, fire, lava, and quakes drove thousands of people from their homes. A fearsome eruption in 1950-51 was the worst in fifty years.

ETRU'RIA. Long before the legions of Rome marched over the known world, the people of Etruria had their own civilization. They lived on the Italian peninsula in the region bounded by the Tiber, the Apennines, and the Mediterranean Sea. Called Etruscans, they had a language and an alphabet similar to those of the earliest Greeks, for both peoples had contact with the Phoenicians, from whom their alphabet was derived. In Etruscan tombs have been found silver, bronze, ivory, and gold ornaments and other works of art that show great skill; these objects are considered to have been fashioned 600 or 700 years before Christ. Ancient chariots and sculpture also have been found.

In the days when Rome was beginning to feel her power, the Etruscans were constant foes of the growing city. Finally, in



Courtesy Metropolitan Museum of Art

ARTISTIC MASTERPIECES OF THE UNKNOWN RACE

The Etruscans left little to tell us of their history, but their superb works of art reveal a highly developed civilization. (1) The head of a terra-cotta statue of a lancer. The heroic figure is eight feet tall. (2) Part of an Etruscan fresco. (3) The famous bronze "She-wolf." (4) A statuette of Demeter. (5) A sphinx-handled vase.

396 B.C., Rome began to conquer them, and by 283 B.C., the entire land of Etruria was under the sway of Rome. Etruria formed one of the first provinces of Rome and contributed much in the way of men and money to the Roman Republic and, later, the Roman Empire. See ROME.

ETYMOLOGY, *et i mol'o je.* Words and man have grown up together. Etymology, the study of words, might well be called the family album of man's life history. For, as civilization has changed, man has molded his language to meet his needs. If there is not a suitable word to express what he wishes to say, man may invent or borrow one which is gradually accepted by others.

To understand the scope of this study, you need only take down the dictionary from your bookshelf and study it. Perhaps it never occurred to you that a dictionary is interesting to read, yet an unabridged version is full of fascinating word histories.

Modern English is primarily a combination of the Anglo-Saxon tongues of Northern Europe and the Latin and Greek of Southern Europe. Students believe that the Saxon and the Latin and perhaps other languages developed from a common source. It is interesting, for example, to find that the word *mother* in English is *mater* in Latin, *mere* in French, *mader* in Persian, *mata* in Sanskrit, and *Mutter* in German.

Words are constantly changing. Many of our best words today were once slang. Moreover, their present meanings may not even faintly resemble the original ones.

Word development is a fascinating study. *Villain* has meant at various times a peasant, a clown, a boor, and now a scoundrel. Its root word, *villa,* is from the Latin word for *town;* it also forms the root for our word *village.* See LANGUAGES OF THE WORLD.

EUCALYPTUS, *u ka lip'tus.* With their swaying branches and bright foliage, eucalyptus trees are excellent for street and highway planting. Botanists have identified more than 150 species. They are native to Australia and Tasmania, but have been planted in Southern Europe, Northern Africa, Southern Asia, and tropical South America, as well as in Southern California and Florida.

The eucalypts will stand but little cold weather and are great lovers of moist situations. They grow best, in the United States, in irrigated sections of Southern California. The *blue gum,* a rapid grower, is most generally planted. There is a record of one tree which, at three years and two months from the seed, measured nine inches in diameter and forty-two feet, six inches in height. This is a height growth of over thirteen feet per year.

Owing to their rapid growth, the eucalypts have been largely used for windbreaks about the orange and lemon groves of California. As fuel wood is scarce and very expensive in that region, the eucalyptus trees are planted to produce crops of firewood. They grow to a great height, usually with one central stem. A valuable oil is obtained from the trees, while the sweet-scented flowers are a source of honey for the bees.

EUCHARIST, *u'ka rist.* Nearly all Christian Churches have as a part of their worship a re-enactment of the Lord's Supper, called the Eucharist. This term is used loosely to mean Communion, or that part of the service in which the consecrated bread and wine are served to the members of the Church. Actually, however, the word refers strictly to the sacrament of the Roman Catholic Church, in which the bread and wine, in Catholic belief, are transformed into the actual body and blood of Jesus. Belief in this miraculous rite, called transubstantiation, is rejected by nearly all Protestants and constitutes one of the main points of difference between the two religious groups. The word was originally the Greek for *thanksgiving.*

EUCLID, *u'klid.* It has been more than 2,200 years since Euclid lived, yet high school pupils today still study the principles of geometry which he drew up. No mathematician has ever been able to surpass his methods, and his *Elements of Geometry,*

THE FATHER OF GEOMETRY TEACHES SOME LUCKY STUDENTS

It must indeed have been a great privilege to learn geometry with the greatest authority on the subject who ever lived. Euclid was this colossus of mathematics, and more than 2,000 years ago he wrote his famous *Elements of Geometry* in thirteen books. Of Euclid's private life, little is known. He was a citizen of Alexandria—one of those Greeks who established themselves in the Egyptian city after its founding by Alexander the Great. His books were published about 300 B.C., and remain the standard authority.

written about 300 B. C., is still considered the fundamental work in geometry.

Not much is known of Euclid's life. He was a Greek and lived in Alexandria, the Egyptian city founded by Alexander the Great.

EUPHRATES, *u fra'teez.* If a river could talk, what a story the Euphrates could tell!

It could describe the comings and goings of the ancient Sumerians, Akkadians, and Amorites, who wandered along its shores in a mysterious long ago. It could tell us of the kindly patriarch Abraham, who left its fertile banks to lead a people who believed in one God. It could describe the glorious city of Babylon with its Hanging Gardens and fabulous Tower of Babel, and ancient Baghdad, with all its Oriental magic. Rolling chariots of the Assyrians and marching feet of the Chaldeans; civilizations older than history; life thousands of years more ancient than any records we possess; even, perhaps, the Biblical Garden of Eden—all of these the Euphrates has seen.

Having its sources far up in the mountains of Armenia, the Euphrates flows through the "Fertile Crescent," the historic land so treasured by people of Mohammedan faith. Two branches of the river, the Eastern and Western Euphrates, stretch across Turkey in a westerly direction, then run south to Syria, and finally southwest through the alluvial plains of Iraq, which it formed in its meanderings throughout the ages. One hundred miles north of the Persian Gulf, the Euphrates joins the Tigris, and together they flow into the sea as the *Shat-el-Arab*. The total length of the Euphrates is 1,800 miles, and the basin, consisting of 260,000 square miles, is extremely fertile; this fertility accounts for the growth of civilization along its banks. Boats can navigate the Euphrates for a distance of 1,100 miles. See ASSYRIA; BABYLONIA; IRAQ.

EURIPIDES, *u rip'i deez* (about 480-406 B. C.). Modern drama, a heritage from the Greeks who invented it, owes much to Euripides, for it was he who brought the feelings of human beings onto the stage in tragic plays. Authorities on the drama rank Euripides below Aeschylus and Sophocles in greatness, mainly because the characters in his dramas do not possess the godlike qualities which the ancients required of their characters. Yet, the tragic situations and skill found in his plays must place him high in any list of the world's greatest playwrights.

CLASSIC TRAGEDIAN—EURIPIDES

Euripides was tutored during his youth by Prodicus and Anaxagoras. His first play, *The Daughters of Pelias,* was produced when he was a young man, and in 441 B. C. he was awarded first prize in the annual dramatic competition. Euripides competed for the prize for many years, and altogether wrote more than seventy plays. Eighteen of these still exist, some of them being *Electra, Orestes, Medea, Iphigenia in Tauris, Iphigenia in Aulis, Alcestis,* and *Andromache.*

EUROPA. The eventful career of Zeus, supreme among the gods of ancient Greece, included a number of kidnapings, and one of these was the abduction of Europa, the comely daughter of Agenor, king of the Phoenicians. According to the fable, Zeus turned himself into a bull and carried away the girl. Changed back to normal appearance, Zeus married Europa, but eventually gave her to the king of Crete.

A NEIGHBORHOOD of NATIONS

Scene of Ever-Shifting Political Import

EUROPE. Although Europe is the smallest of the continents with the exception of Australia, it has been, for more than a thousand years, the most important of them all. The most ancient civilizations of the world began in Asia and Africa; but it was in Europe that modern industry, education, art, music, and every other advancement in civilization was developed. It was in Europe, too, that a large majority of the white race advanced from savagery to a high state of civilization and that Christianity was developed into one of the world's great religions.

Size and Population. Projecting as a great peninsula from the western side of Asia, Europe has an area of 3,754,282 square miles, not much larger than that of the United States. Yet, within this limited area are some thirty nations, nearly all of which have distinctive languages and customs. With a total population of about 554,000,000, Europe is the most densely populated of all continents, having an average of about 145 persons to the square mile. In England and Belgium, the population is normally the most crowded in the world.

Coast Line and Islands. Extending from the Arctic Ocean on the north to the Mediterranean on the south, Europe has a coast line estimated at from 20,000 to 48,000 miles, one of the longest and most irregular to be found anywhere.

Chief among European coastal waters are: on the north, the White Sea; on the east, the Caspian Sea; on the south, the Black Sea, Sea of Azov, the Bosporus, Sea of Marmora, the Dardanelles, Aegean Sea, Adriatic Sea, Mediterranean Sea, Gulf of Genoa, Gulf of Lyons, and the Strait of Gibraltar; and on the west, the Bay of Biscay, English Channel, North Sea, Baltic Sea, Gulf of Bothnia, and Gulf of Finland.

Many important peninsulas thrust themselves out from the European mainland. On the west two prominent peninsulas formed are those of Denmark and of Norway and Sweden; and on the south are Italy, Spain, and the Balkans, including Greece and Albania.

Around the coast of the continent are scattered many important islands, chief among them being the British Isles, Iceland, Corsica, Sardinia, Sicily, and Crete.

HIGHEST AND LOWEST IN EUROPE
Holland, land of canals (left), whose windmills spin on areas reclaimed from the sea. Far away is mountainous Switzerland (right), where cities look up at towering, snowy Alps.

A Rugged Continent. In spite of the fact that nearly two thirds of the continent is low land, Europe is broken by a number of separate mountain ranges. Most of them lie in the south and run in a general east-west direction. This location affects the climate of Europe in that the prevailing westerlies, blowing between the mountain ranges, carry rainfall from the Atlantic well across the continent.

The Kjölen Mountains in Norway and Sweden run in a southwest direction and are quite extensive in Norway. In Spain the lofty Pyrenees, flanked by many lower ranges, rear their heights along the northern boundary between Spain and France; and the Cantabrians lie along the northern coast. Throughout much of Eastern France, Southern Germany, and Northern Italy extend the famous Alps, containing many noted peaks such as Mont Blanc, Monte Rosa, and the Matterhorn. Some of these peaks exceed 15,000 feet in altitude. Although the Alps cover the whole of Switzerland, the Swiss have taken advantage of this seeming handicap and have turned their country into a playground for the world's winter sports.

North and east of the Alps are the Carpathians and other ranges, including, to the north, the Jura and Harz. Although Russia consists chiefly of a vast plain, it has two mountain ranges; the Urals, forming a natural barrier between European Russia and Siberia; and the Caucasus, a lofty boundary in the south, which separates Russia from Asia Minor. Other important European ranges are the Apennines, the "backbone of Italy"; the Sierras, lofty ranges covering Central Spain; and the Grampian Mountains in Scotland.

A Well-Drained Continent. Because of the low land in the north and the mountainous areas in the south, most of Europe's large rivers flow in a northerly direction. Chief among these are the Elbe, the Rhine, the Oder, and the Vistula. Flowing through Southern France, and emptying into the Mediterranean, is the Rhone. The Po, rising in the Alps, flows across Northern Italy and empties into the Adriatic. The Danube, of great importance com-

Left, courtesy James Boring and Co.
Right, courtesy Raymond-Whitcomb, Inc.

BETWEEN THESE LIES EUROPE—TWO EXTREMES OF CLIMATE
Left, flimsy homes of the sunny south. Right, a steep-roofed church in chilly Norway.

mercially, rises in Germany and follows a wandering course through Central Europe to the Black Sea. Of considerable value in navigation are the Seine, in Northern France, emptying into the North Sea; and the Tagus, rising in Spain and flowing through Portugal into the Atlantic.

Russia has a number of rivers, chief among them being the Volga, flowing in a meandering course into the Caspian Sea; the Dnieper, flowing southward into the Black Sea; the Don, flowing into the Sea of Azov; and the Duna, flowing west through Lithuania into the Gulf of Riga. The Dvina, another Russian river, flows into the White Sea; it is of little value because of its frozen condition during many months of the year.

The lakes of Europe naturally divide themselves into two groups, the southern and the northern. The southern group includes those on both sides of the Alps, notable among them being lakes Geneva, Neuchâtel, Lucerne, Zurich, and Constance in Switzerland; and Como, Lugano, Garda, and Iseo in Italy. The northern lakes are scattered across Sweden, Finland, and Russia. The largest, Ladoga and Onega, are in Russia.

Mineral Resources. Almost every known metal is to be found in Europe. Coal and iron, the most important, are

LAND OF PROUD TRADITION
Europe's cities share one thing—age. Together they are the "Old World." Left, ruined Grecian temple. Right, old Gothic door in France.

mined in almost every highland region. The principal fields of these ores lie in the British Isles, Norway, Sweden, Germany, France, and Belgium. Norway and Sweden also have extensive silver deposits. Quicksilver is mined in Central Germany, Spain, and Russia. Around the Black and Caspian seas in Southern Russia are some of the world's greatest petroleum fields. Tin is found in England and Brittany; and in Italy are found great quarries of marble, granite, and limestone.

The Climate. Lying almost wholly within the temperate zone, Europe has a generally mild climate, especially in its western areas, which are warmed by ocean currents and southwest winds. Even the British Isles have a mild climate in spite of their northern latitude. But these winds, as they sweep northwest, and the currents, flowing almost due north, tend to lose their moderating effect, and greater extremes of temperature exist in Eastern Europe than in Western Europe. Along the southern shores of the continent, mild temperatures prevail the year around, owing to the influence of the warm waters of the Mediterranean and the blocking of the cold north winds by the Alps and other lofty mountains. Although rainfall is not heavy in Eastern Europe, very few sections find irrigation necessary, for almost everywhere there is sufficient rainfall for agriculture.

Vegetation and Animal Life. In the extreme north, where Arctic conditions prevail, is found the tundra type of vegetation, but almost everywhere else trees flourish. There is the usual change and gradation in the character of these trees from north to south—pines, firs, and birch in the north; oak and beech in the great central-plain region; the chestnut next; and in the south the olive, orange, and lemon. The central plain is one of the great wheat-producing regions of the world; and Europe ranks high among the continents, also, in the production of oats, sugar beets, and potatoes. Rye, corn, and grapes are extensively raised, the latter chiefly along the Mediterranean. Over much of Europe, especially in the western areas, farming is carried on extensively, for every available foot of space must be cultivated to feed the hungry masses.

In the north of Europe are still found the reindeer and the polar bear; bears live, too, in the more inaccessible forests farther south; great packs of wolves prowl through the woods and plains of Russia and Poland; and the chamois abounds in the Alpine region. Chief among the domestic beasts

Left, courtesy Raymond-Whitcomb, Inc.

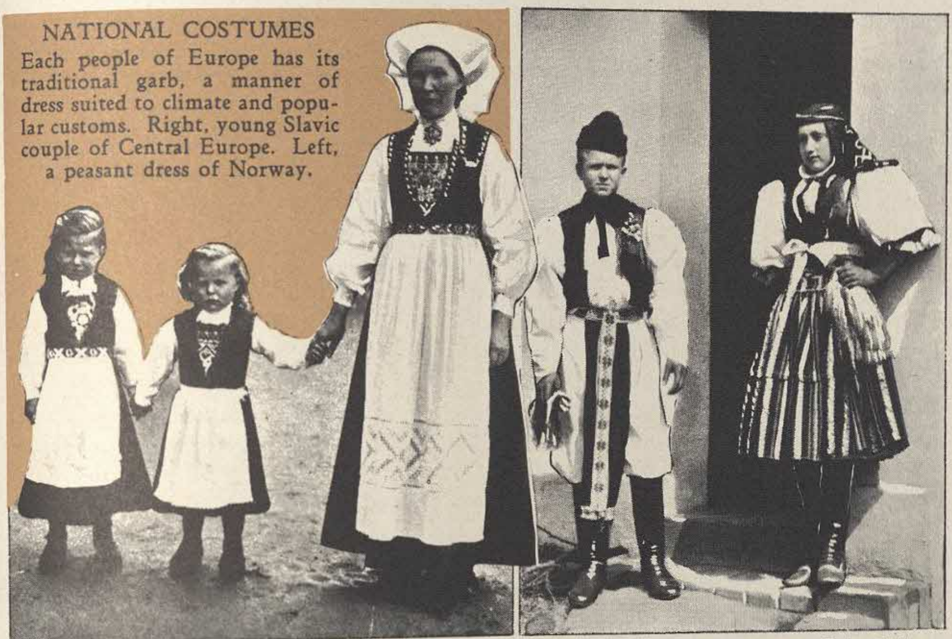
TIME-WORN CUSTOMS CLING
Europe's history speaks in buildings, and in costumes, too. Left, the Old Palace Gate, Bordeaux. Right, a German-Swiss in costume.

of burden are the mule and ass, particularly in Spain and south of the Alps. Fishing is a leading industry along the European shores, although the Mediterranean has no large fisheries. The nations along the North Sea depend upon fish for a large part of their food supply. There, cod, herring, mackerel, and salmon are caught in vast quantities.

Europe's Mixture of Peoples. No continent in the world presents such a wide variety of peoples as does Europe. At one time, Western Europe from the Alps to the British Isles was held by the Celts. Broken under succeeding invasions of the Romans and Germans, the Celts were scattered; and today their language is spoken in the Scottish Highlands (Gaelic); in Wales (Cymric); in Brittany (Armorican); and in Eire, where Gaelic is official.

The Teutonic races, next in historical importance, include not only the Germans, Dutch, and English, but also the Norwegians, Swedes, and Danes. Farther east live the Slavonic peoples, including the Russians, Poles, Bohemians (Czechs), Serbians, Croatians, and several lesser groups. In Southeastern Europe, the Greeks are the dominant race; farther west, along the shores of the Mediterranean, live the Latin peoples, including the Italians, French, Spanish, and Portuguese. In addition to these peoples are those of several eastern nations; the Hungarians, Finns, Lapps, and Turks are descended from the Mongolian hordes who entered Europe from Asia. The Basques of Northern Spain are among the "mystery" peoples of Europe, for little is known of their ancestry.

By far the vast majority of European peoples are of Christian faith. Outstanding are the Roman Catholic Church; the various Protestant churches—Methodist, Baptist, Anglican, Calvinist, and Lutheran; and the Greek Orthodox Church, the one formerly recognized in Old Russia. The Jewish and Mohammedan faiths are also found in Europe.



NATIONAL COSTUMES
Each people of Europe has its traditional garb, a manner of dress suited to climate and popular customs. Right, young Slavic couple of Central Europe. Left, a peasant dress of Norway.

Ewing Galloway

History. European history began in ancient Greece about 776 B.C., and Greek culture reached its greatest height about the year 430 B.C. From Greece, civilization moved westward to Rome, which conquered not only Greece but Gaul, Helvetia, Spain, parts of Germany, and several smaller areas, early in the Christian Era. Under Roman rule the arts and laws reached a new high level in Western Europe and continued until the decline of the Roman Empire. Immediately following this decline, northern tribes began migrations that ended with the Franks settling in France, the Ostrogoths and Lombards in Italy, and the Anglo-Saxons in Britain.

The next great change that took place in Europe came under Charlemagne, the great French ruler, who conquered a vast territory covering what is now France, Germany, Italy, Burgundy, Lorraine, and Navarre. Eastern Europe, at about the same time, was invaded by the Slavs, who founded kingdoms in Russia, Poland, Northern Germany, and Bohemia. The Magyars appeared in Hungary, and the Normans, or Norsemen, founded kingdoms in France, England, and Sicily.

From the twelfth to the fifteenth centuries, the Turks advanced into Eastern Europe from Asia, driving out the highly cultured Greeks and stirring up the emotional reaction that led to the Crusades to the Holy Land. A blessing in disguise, this Turkish invasion caused a migration of Greek scholars to the western countries, spreading new culture throughout much of Europe. This spread of culture led to the Renaissance and was materially aided by the invention of printing.

It was also during this period that Spain took the lead in the discovery and colonization of new lands. Beginning with the discovery of America by Columbus in 1492, the Spaniards dominated exploration for some time, but were succeeded by the French and the English. In 1789 occurred the French Revolution, followed by the Napoleonic Wars which broke up the old German empire.

Since that time, the history of Europe has been a fast-moving drama of one war after another. After being in the hands of the Turks for more than 350 years, the Greeks revolted and gained their independence in a war which lasted from 1821 to 1833. Poland crumbled and, by 1795, had been absorbed by Prussia, Austria, and Russia.

Beginning with the nineteenth century, every few years have brought a war involving one or more European nations. Boundary disputes, old international grudges, colonization quarrels, greed, and the continued refusal of people of different tongues to unite under a common flag have been outstanding among the causes of these historic struggles.

World War I destroyed old boundaries and created new nations. But the Treaty of Versailles ending the conflict also created many new problems and resentments. Then democracy was challenged by the theory that the individual must be subservient to the state. This theory triumphed as Fascism in Italy and Spain; as Communism in Russia; as Nazism in Germany.

Under Hitler, Germany embarked on a career of conquest that resulted in World War II, in which only Sweden, Switzerland, Spain, Portugal, and Eire preserved their neutrality. Waged with fury from 1939 until 1945, this titanic struggle was the most destructive in life and property the world had ever seen. At its close, the battered nations faced a gigantic task of reconstruction, critical economic problems, and political conflicts that soon developed into a bitter "cold war" between those favoring Communism and those devoted to freedom.

After Russia had extended its boundary and influence westward in an arc reaching from the Baltic to the Black Sea, the aroused Western democracies took many steps to prevent aggression and the further spread of Communism. Chief among these was the formation of the North Atlantic Treaty Organization and a defensive army. Aid for European recovery, largely from the United States, included billions of dollars in gifts and loans, as well as technical and military assistance. Although great progress was made, Europe remained one of the most critically troubled continents of a world in turmoil.

The political divisions of Europe are treated in this work under separate headings. Consult also the following titles:

GEOGRAPHY

Adriatic Sea
Alps
Arctic Ocean and Lands
Atlantic Ocean
Baltic Sea
Black Forest
Black Sea
Bosporus
Carpathian Mountains
Caspian Sea
Caucasus
Danube
Dardanelles
Dnieper
Dniester
Elbe
English Channel
Gibraltar
Jungfrau
Loire
Marmora, Sea of
Marne
Matterhorn
Mediterranean Sea
Mont Blanc
Neva
North Sea
Olympus
Parnassus
Pyrenees
Rhine
Rhone
Rubicon
Saint Gotthard
Scheldt
Seine
Simplon
Tiber
Ural Mountains
Volga
Vosges Mountains
White Sea

HISTORY

Charlemagne
Chivalry
Crusades
Feudal System
Franco-German War
French Revolution
Holy Roman Empire
Hundred Years' War
Knighthood
Napoleon I
Nations, League of
NATO
Reformation, The
Renaissance
Roman Catholic Church
Seven Years' War
Succession Wars
Thirty Years' War
Triple Alliance
Triple Entente
United Nations
World War (I, II)

EUSTACHIAN, *u sta′ ḳi an,* **TUBES.** When you ride swiftly in an elevator to the top of a skyscraper, or in an airplane that roars up into the sky, taking you up in a steep climb, you may notice a strange pressure in your ears. You swallow, there is a slight cracking sound, and the pressure is gone. You can thank your Eustachian tubes, those safety valves of the human ear. They were named for Bartolommeo Eustachio, an Italian surgeon of the sixteenth century who was the first to study the structure of the inner ear.

These tubes are air passages extending from inside the middle ear to the pharynx. They permit air from the throat to reach the inside of the eardrums, thus keeping atmospheric pressure equal on the inside and outside of the drums. This is essential to good hearing. When the Eustachian tubes become inflamed, they sometimes shut off the tiny air passage, causing head noises and partial or total deafness. See EAR.

EVANGEL'ICAL CHURCH. Pennsylvania German churchmen, led by Jacob Allbright, organized the original Evangelical Association, which held its first general conference in 1816. In 1891 a seceding group formed the United Evangelical Church, but in 1922 this schism was healed and the two churches again became one under the name of the Evangelical Church. In 1934, a third related group, called the Reformed Church, entered the union, which is now known as the Reformed and Evangelical Church.

EVANGELINE, *e van' jel in.* Few stories are as sad or as tragic as *Evangeline,* a beautiful poem by Henry Wadsworth Longfellow. Based on the cruel treatment of the Acadians, who lived in the land now known as Nova Scotia, the poem deals with the search of Evangeline for her lover, Gabriel. They were separated at the time British ships took hundreds of the French peasants to the American colonies, in 1755. In the course of her search for Gabriel, Evangeline wandered through the colonies, and traveled down the Ohio and Mississippi rivers to Louisiana. She finally found him in Pennsylvania when they were both very old and he lay dying.

Evangeline is described as

> Lovelier than a star
> When only one is shining in the night.
>
> * * * * * * *
>
> When she had passed, it seemed like the ceasing of exquisite music.

Nathaniel Hawthorne, the novelist, had heard a story about two Acadian lovers who were united after years of separation. It was at his suggestion that Longfellow wove the tale into the exquisite poem so widely known and loved. It was published in 1847. It is written in blank verse, in dactylic hexameter.

For the historic background of *Evangeline,* see ACADIA.

EVANS, MARY ANN. See ELIOT, GEORGE.

EVAPORATION, *e vap o ra' shun.* If you place a pan containing a little water anywhere in a warm, dry room, you will find the pan empty in a very short time. What has happened is that the water has changed to an invisible vapor or gas and has risen into the air, by the process of evaporation. Wherever water in any form exists, evaporation will take place. Even ice will continue to evaporate slowly in cold weather. The higher the temperature, the faster will be the evaporation.

The rate of evaporation also depends upon the amount of moisture already in the air. When air will absorb no more moisture, it is said to be *saturated.* The amount of moisture in the air determines its state of *humidity.*

The effect of evaporation upon human beings is very great, for all rainfall is a direct result of this process. Moisture from rivers, lakes, and streams is drawn into the air in gaseous form, and carried as clouds over the land, where it condenses and falls as soon as it strikes a cool area. In this way, the earth's moisture is constantly being redistributed. Without evaporation, the world would soon become a barren desert, plant and animal life would disappear, and the very air would become unfit to breathe.

The loss of moisture by evaporation is a very important factor in agriculture, especially in arid or semi-arid regions. Rainfall efficiency is determined not only by the amount of precipitation but also by the rate of evaporation. Because of this fact, a total of twenty-one inches of rainfall in the Texas Panhandle is of less value to crops than fifteen inches in the Northern Great Plains. Dry farming is a means of overcoming this difficulty (see DRY FARMING), as one of its purposes is to retard evaporation by creating a surface dust.

Evaporation also serves man by keeping him cool. Perspiration on the body disappears by evaporation, causing the skin to become cooled and lowering the temperature of the blood. This process is hastened in the summer by means of electric fans, which cause a more rapid rate of evaporation. Because evaporation is retarded when air is humid, people suffer more from heat in a humid climate than in a hot, dry one.

EVENING STAR. When the sun sets, the first "star" seen in the western sky is called the "evening star." Actually, it is a planet and not a true star (see ASTRONOMY). Nor is it always the same planet, for different ones appear at twilight at different seasons, depending on their position in their orbit around the sun. When Venus is in the west, just east of the sun at dusk, it is the evening star. When west of the sun and the last star of the morning, Venus is called the "morning star." Mercury, Mars, Jupiter, and Saturn also appear as the evening and the morning stars.

EV′EREST, MOUNT. Towering high above the Nepal-Tibet border, in the heart of the Himalayas, stands majestic Mount Everest, the highest peak in the world. It was named for Sir George Everest, the surveyor-general of India in 1841. Its height was placed by the British in 1850 as 29,002 feet, and by the Republic of India in 1954 as 29,028 feet. Mount Everest was climbed for the first time in 1953 by Edmund Hillary of New Zealand and Tanzing Norkey, a Nepalese living in India. Two Swiss expeditions climbed it in 1956. Improved oxygen equipment made ascent possible. In 1952 Communist China restored the mountain's ancient Tibetan name, *Chomo-lungma,* which means *Goddess Mother of Mountains.*

EV′ERGLADES. Covering an area of some 5,000 square miles, about the size of Connecticut, this area in southern Florida has been called "America's last frontier." Although many millions of its acres have been drained and turned into fertile farm land, producing sugar cane and other Southern crops, a vast area remains an untamed, swampy wilderness. Rising above its dark, brackish waters are moss-draped cypress trees, cypress "knees," coarse, saw-edged grasses, and other marsh vegetation. Here and there a treeless, grassy plain, or savanna, is found, as are many islands thick with oaks, palms, and palmetto.

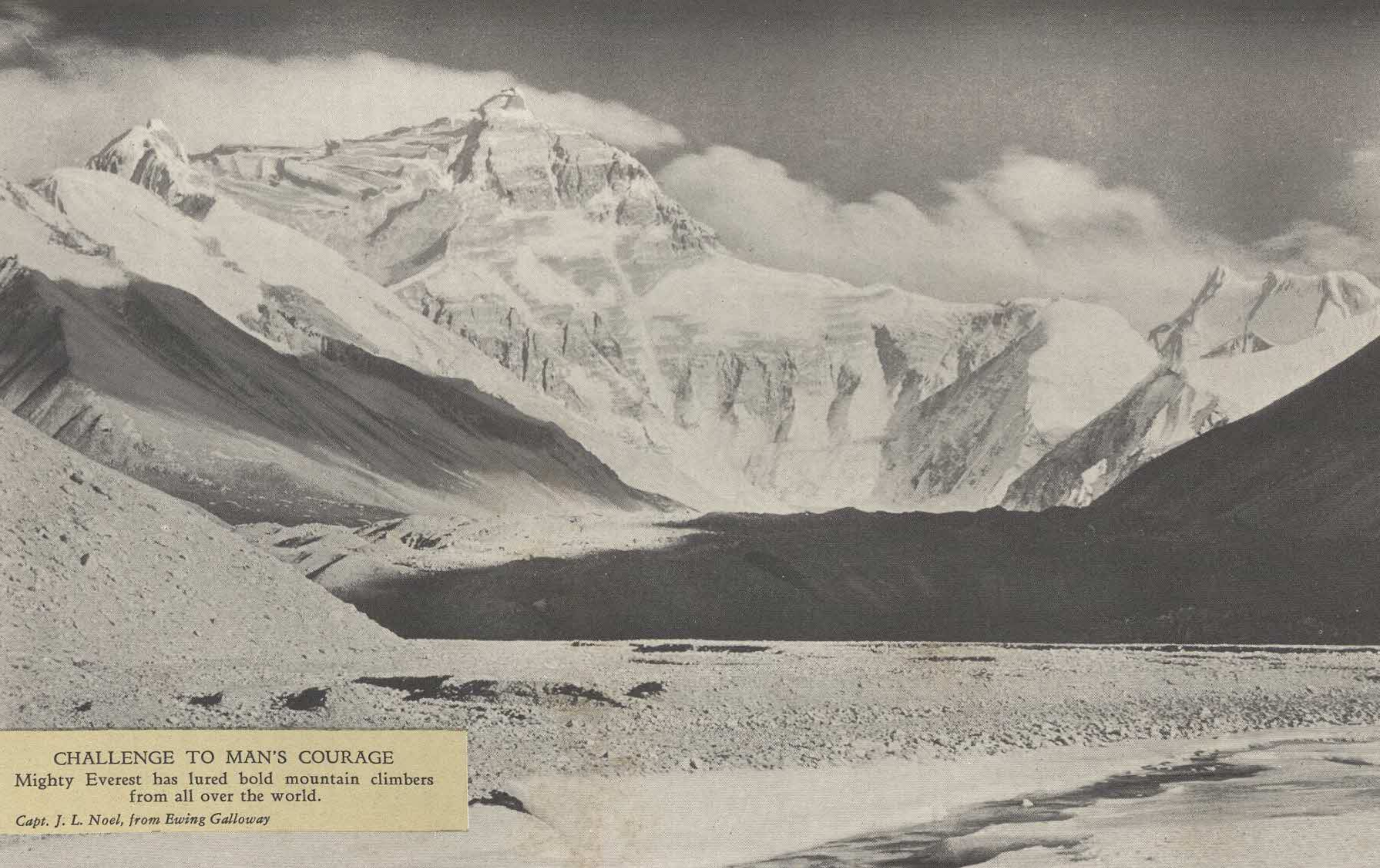
For many years, its Seminole Indian inhabitants were practically the only people who ever ventured into this semitropical jungle. And even today, only a few hunters and sightseers make boat trips into its dark, lonely interior. But many motorists travel over the Tamiami Trail, the fine, modern highway that was built across it in 1928, and more than 1,000,000 of its southernmost acres have been set aside for the Everglades National Park, created in 1947. Among the many birds and animals found in the Everglades are wild ducks, herons, kingfishers, crocodiles, alligators, and snakes. See FLORIDA; SEMINOLE.

EVERGREEN. This name applied to a tree means just what it says — that the tree is ever green, as are evergreen plants. Unlike deciduous trees and plants, the evergreens retain some of their leaves throughout the year, though many of them are shedding part of their foliage most of the time.

Evergreen leaves are tough and can stand frosts. This is especially true of the needle-shaped leaves of the cone-bearing evergreens, which have a smaller surface than most leaves. The waxy surface of their leaves also enables the evergreens to retain their moisture so well that they can live with a smaller amount of water than many other trees.

Well-known evergreen trees include pines, firs, hemlocks, spruces, cedars, yews, and some cypresses. Smaller evergreens include the rhododendron, laurel, and some magnolias, myrtles, and ivies.

EVOLU′TION. It is the belief of many modern scientists that man and the living species of higher animals, and of birds, insects, flowers, and trees, have not always existed in just the forms we see today. Rather, they have developed slowly, through constant but gradual change. They have evolved over millions of years, their life forms adapting themselves under the influence of climate, surroundings, and their



CHALLENGE TO MAN'S COURAGE

Mighty Everest has lured bold mountain climbers from all over the world.

Capt. J. L. Noel, from Ewing Galloway

struggle for existence. This is the theory of evolution, and it is supported by the evidence of skeletons and fossils found in ancient rocks.

The evolutionists hold that all living things trace their ancestry back to simpler types or to a few common forms. They have found evidence that the horse was once a small animal, perhaps the size of a house cat; and instead of hoofs he had four-toed front feet and three-toed hind feet. They point to similarities in body structure between fish, amphibians (such as frogs), serpents, birds, and mammals. It is believed that in the distant, prehistoric past, the earth was almost entirely covered with water, that life perhaps originated in the sea, with simple, one-cell beings such as the amoeba, and the scumlike algae found in stagnant pools.

When the waters receded, some forms of life were stranded on land and a few managed to accustom themselves to the new conditions of their home, at first dividing their time between land and water. Gradually, higher forms adapted to life on land developed. As these forms scattered to different lands and climates, changes were necessary in their habits and body structure to permit their survival in hot and cold climates, in mountainous and desert countries, and in damp and dry soils. Bearing out the old saying that necessity is the mother of invention, animal life developed according to the demands of its environment, and these changes were passed on from parent to offspring.

Cross-breeding among different species and *mutations* were factors. Mutations, or *sports,* are radical changes or "jumps" in evolution. The offspring of normal plants and animals may differ very greatly from their parents—so much that they may have the appearance of a new species. On any fruit stand we may see evidence of this fact. The large, seedless, navel orange first appeared as a mutation and since has been produced commercially by man through careful cultivation.

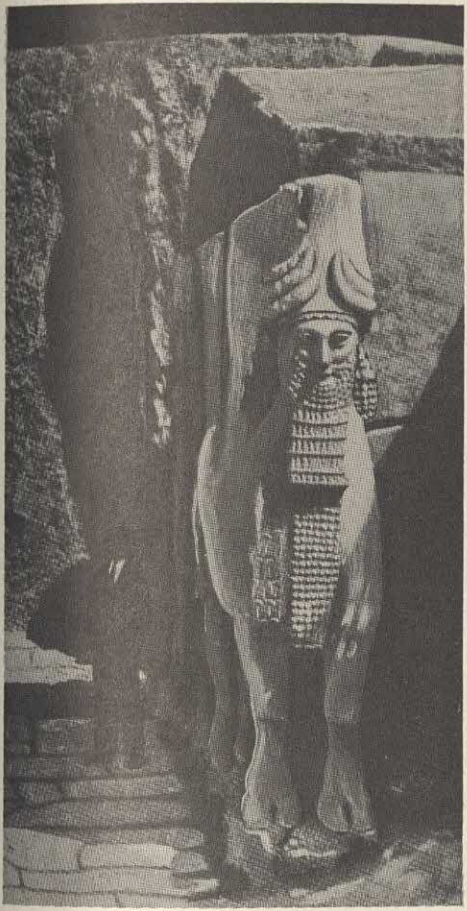
With the growth of geological research, such as the study of rock layers of different ages, considerable material has been obtained to support these theories. As animals and plants died and were covered by soil, their shapes or skeletons or leaf patterns were preserved in the layers of rock which gradually formed one on top of another through passing ages. Through the examination of these layers, the life history of an animal form may be traced back for millions of years.

First to present the theory of evolution in systematic detail was Charles Darwin, who included man among the creatures evolved from early forms. Even if man originally did not differ greatly from apes in physical structure, he did possess some quality that set him apart from all other forms of life—the quality that distinguishes a human being from a brute.

The theory of evolution for years was abhorrent to many believers in Christianity, for they could not reconcile it with Bible teachings of the Creation. Today, however, many Christian leaders are more and more accepting the scientific explanation of the development of life, believing that the laws of nature bear witness to the orderly plan of a divine power above all. See DARWIN, CHARLES R.; FOSSIL; GEOLOGY.

EXCAVATIONS IN ANCIENT LANDS. Gradually, as time goes on, men are finding out more about their ancestors and how they lived, by digging through the sand and silt that has covered ancient cities and regions. These excavations, carried on by universities, museums, scientific organizations, and other institutions, have unearthed tablets, statues, pottery, vases, jewelry, utensils, and ornaments that tell of ancient cultures which the modern world has inherited.

Some of the most extensive excavations have been carried on in Greece and the near-by islands of the Mediterranean Sea; Germany, Spain, France, England, Egypt, Italy, Mesopotamia, and Central and South America. The results have helped piece together the story of man's past, but there remain many details which only further



ANCIENT ASSYRIA REVEALED
Archaeological excavations at Persepolis.

excavations can hope to disclose. See Archaeology.

EXCHANGE'. In business, exchange is a way of transferring the value of money from one place to another without actually shipping the money. People in different cities and countries are constantly trading with one another, making a method such as exchange not only desirable but possible.

For example, A in New York pays his home banking agency for the goods he purchased from B in Chicago. A, in turn, receives a draft, or bill of exchange, to send to B. In Chicago, B takes the draft to his bank and receives money for it. The money that A gave the bank in New York will be paid sometime in New York to another person who receives a draft from Chicago. In this way, debts are canceled without the transference of money to and from cities.

Debts and obligations between individuals of different nations are also settled in this manner. When an Englishman makes a payment on a debt in the United States, he gives his bank the money and sends a draft to the United States, where American banks accept it.

Exchange is said to be at *par* if a bill for $100, drawn in New York for payment elsewhere, can be purchased for $100 in the foreign country. If it can be purchased elsewhere more cheaply, it is said to be *above par* on the home market. If it can be purchased more cheaply in the home market, it is said to be *below par*. A surplus of bills of exchange may cause cheaper rates on one market, to permit the conversion into cash of some of the drafts held. See Draft.

EXCISE, *ek' size,* **TAX.** This is a duty levied by a government on articles sold, used, or produced within the territory under its jurisdiction. A sales tax is an example. Excise taxes differ from customs duties and tariffs, which are levied on imports. See Customs Duties; Internal Revenue; Tariff.

EXECUTIVE DEPARTMENT. See Constitution of the United States; President; United States of America.

EXERCISE. See Physical Education.

EX'ETER. In May, 1942, Germany gloated, "Exeter was a jewel. We have destroyed it." Over half of England's oldest city, whose quiet and picturesque old-world charm had yearly attracted crowds of sightseers, had become a victim of the World War II blitz. But its famous cathedral, begun in the 1100's, was only slightly damaged, and the remains of its once-defensive wall and enough of its other medieval structures survived for the English to make immediate plans for its restoration. Exeter was to go on being the trading, cultural, and religious center for the surrounding farms of hilly, fertile Devonshire and a tourist's constant delight. Old before the birth of Christ, Isca Damnoniorum, as the Roman invaders had called it, was still one of England's treasures.

Historic Exeter lies in southwestern England on the Exe River and near the open sea. The country's oldest canal, cut as early as 1563, links it with the navigable part of the river's estuary and still carries freight. Though chiefly a city of homes and shops, Exeter is also a rail and highway center. The population is about 75,000.

EXODUS, *eks' o dus.* How Moses and his brother Aaron delivered the Jews from Egypt is told in *Exodus,* the second book of the Old Testament. The book includes the story of the plagues that God wrought upon the Egyptians, as well as the story of the wandering of the Israelites in the wilderness, and the formation of the Hebrew laws. Many of the laws and religious observances described in *Exodus* still are followed by Jews today. See BIBLE; BIBLE STORIES.

EXPANSION, *eks pan' shun.* When anything grows larger without containing any more substance, it is said to expand, and the change is called expansion.

Heat Expansion. Most of the objects we come in contact with expand when heated. Telephone and telegraph wires, for example, sag more in summer than in winter, showing that they are longer when hot than when cold.

When water or air is heated, the hotter parts expand and press against the cooler parts, setting up warm currents which flow up and away from, and cold currents which flow down and toward, the source of heat. Such currents, of which winds and ocean currents are practical illustrations, are called *convection* currents.

Cooling Expansion. Some materials expand when cooled. Water expands when it freezes. The expansion of water in freezing is a constant source of exasperation and a great economic blessing at the same time. It is responsible for the destruction of water pipes and of radiators on automobiles; but it helps prepare the seed bed by breaking up the larger lumps of wet soil.

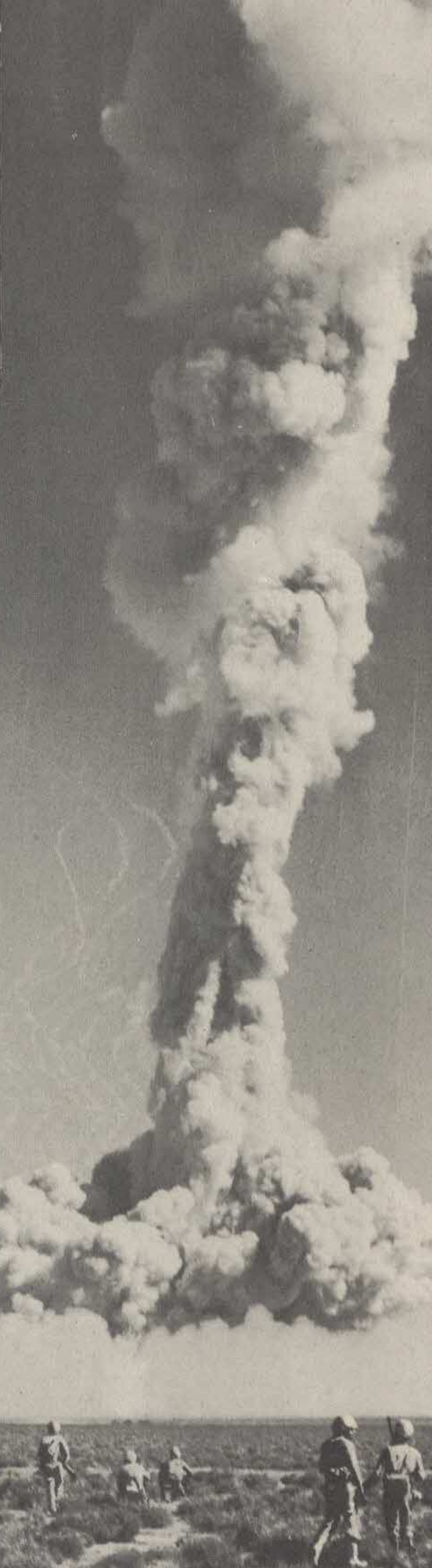
Expansion of Gases. Bread rises because the yeast plants in it are manufacturing carbon dioxide, and this gas is expanding. Heat increases the expansion of gases, but does not cause it, for by their nature (see GAS) gases expand just as far as their surroundings will permit.

The Amount of Expansion. Each solid or liquid substance has its own degree of expansion when heat is applied to it. All gases are practically alike in response to heat and in expanding as rapidly as pressure is removed from them. These facts are made use of in a number of ways. The oven thermometer which indicates heat by a pointer is sometimes made of a curved piece of brass united to a curved piece of iron. When the oven gets hot, the brass expands more than the iron, and straightens the curve.

EXPLOSIVES. Important in both peace and war, explosives are substances which undergo rapid and violent chemical reactions when disturbed by heat, friction, or pressure. Their explosion is due to the sudden, forcible increase in volume caused by an instantaneous chemical change which converts solids or liquids into gases and creates much heat. When gases explode, the quick reaction results in a great increase in volume produced by the effect of heat on the gaseous products.

With very few exceptions, commercial explosives are made by the use of nitrates or nitric acid. They are mechanical mixtures or chemical compounds. Gunpowder is typical of the former, and T.N.T. (trinitrotoluol) of the latter. These two examples are also typical, respectively, of other classes of explosives; namely, low explosives, which are set off by ignition, and high explosives, which are detonated.

Although nothing definite is known about the origin of explosives, their use is at least as old as the manufacture of gunpowder in 1250. The more powerful explosives such as guncotton, nitroglycerine, T.N.T., dynamite, etc., have all been invented since 1845.



U.S. Bureau of Mines; Defense Dept. Photo (Marine Corps)
UNDERGROUND AND IN THE AIR
A coal-dust explosion in a mine caused the blast above. At right, an atomic bomb test.

The reaction of gunpowder illustrates the changes which occur in an explosion. Gunpowder is an intimate mixture of carbon, sulphur, and nitrates. When it is fired, the oxygen of the nitrates combines with the carbon to form the gas carbon dioxide, and with the sulphur to form sulphur dioxide, in both cases producing much heat. The nitrogen is set free with the other gases and heat greatly expands this volume of gases (which is already 300 times as large as the powder from which it came), so that the confined mixture can exert great destructive and disruptive power.

Explosive mixtures include those containing nitrates and those containing chlorates. In the chlorate mixtures, the chlorates play the same part as the nitrates do in gunpowder. Other explosives include nitro-derivatives, fulminates, etc.

Nitro-derivatives, like Volney powder, are made by treating coal-tar products with nitric acid. Nitric-derivatives are formed by the union of nitric acid with cellulose, toluol, or glycerol, in the presence of concentrated sulphuric acid. The cellulose product is guncotton, used chiefly as a filler for torpedoes and mines, and as the basis of smokeless powder, blasting gelatin, and gelatin dynamite. Toluol produces T.N.T., an explosive used in great quantities during both World War I and World War II.

Nitroglycerol, made with glycerol, is a liquid that explodes easily on shock; it is extremely dangerous to handle. On exploding, its volume is enlarged about 100,000 times. Mixed with infusorial earth, wood dust, etc., it is dynamite, which can be transported more safely.

Mercury dissolved in nitric acid, with the addition of alcohol, forms mercury fulminate as a precipitate. This explosive is exceedingly sensitive to rises in temperature and to pressure. Other interesting explosives are picric acid, ammonium nitrate, cordite, lyddite, melinite, shimose, and a mixture of charcoal and liquid air.

Among modern military explosives, the most sensitive is lead azide, which replaced mercury fulminate in World War II. The explosive quality of the atomic bomb, dropped on Japan in August, 1945, is due to the *fission,* or splitting, of the uranium atom (see ATOM SPLITTING).

Explosives as used in many industries are valuable labor savers. They perform many useful tasks in mining coal and other minerals, in quarrying, farming, well drilling, excavating, and road building. Thus explosives balance their destructive work in war with power necessary to progress in times of peace.

For further information, consult:

Blasting
Cordite
Dynamite
Gunpowder
Nitroglycerine
Trinitrotoluol

EXPRESS COMPANY. Unique in transportation is the express company, a commercial enterprise that has existed in the United States for over a century. Its services are varied. It not only ships packages and goods to all parts of the world, but also issues money orders, traveler's checks, and letters of credit. Offices are maintained throughout the world where people may ship articles, receive letters, and leave their money and valuables for safekeeping.

The express company has played an important part in the expansion and commercial life of the United States. Stories of Indian raids and pioneering surround the history of Wells Fargo, one of the first express companies to follow the trail to the West. The express company also has aided business establishments which handle large quantities of merchandise.

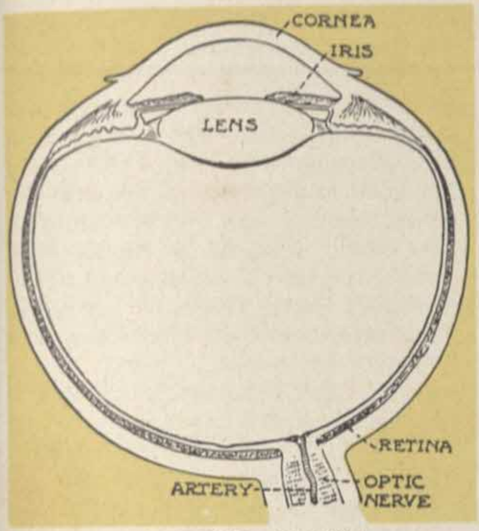
Express companies began with the stagecoach, which carried packages, mail, and money from place to place for a fee. Separate companies were formed about 1840; and, as the nation expanded westward, the express company went with it. During the First World War, the government took over the operation of express companies in the United States. This action resulted in the consolidation of the four leading concerns into one company, now called the Railway Express Agency. Because it is classed as a common carrier, it is subject to the laws of carriers and is regulated by the Interstate Commerce Commission.

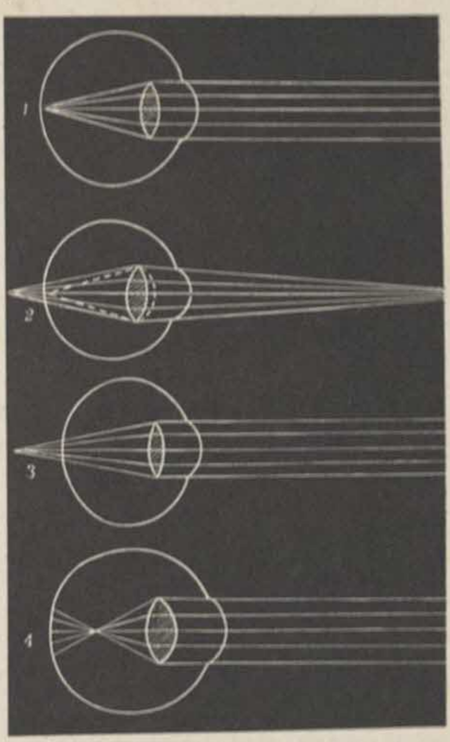
In Europe and other foreign countries, such express companies do not exist. The duties are performed by the government postal services. See COMMON CARRIER.

EYCK, *ike,* HUBERT VAN (about 1366-1426) **and** JAN VAN (about 1380-1441). These two brothers were among the first painters in Northern Europe to show, in their work, objects just as they appear in nature, and they were prominent in the revival of art in Holland. They began their work at Bruges, where the younger brother came to be known as John of Bruges. Later they moved to Ghent. Their most important contribution to the Flemish School of painting was the revival of a process by which paint did not crack. The paintings of the Van Eycks were largely of Biblical scenes and characters, although Jan Van Eyck was also known as a portrait painter. Their greatest work was a series of panels called *The Adoration of the Lamb,* an altarpiece for the Cathedral of Ghent.

EYE. One of the most delicate and wonderful mechanisms of the human body, the eye may be compared to a camera. The organ of sight is usually taken for granted unless disease or injury threatens impairment of that priceless gift, perfect vision.

The eye consists, fundamentally, of only a few parts, much like those of a camera, yet as an optical instrument it is extremely complex and involves many complicated





THE LIVING CAMERA

The marvelous organ of vision, the eye, is quite simple in principle, if not in actual operation. The diagram shows its essential parts—*cornea, iris, lens,* and *retina.* Light passes through the lens, which focuses it on the retina. This picks up the image, sends it to the brain. Right (1), a healthy eye. (2) Focused for close vision. (3) Farsighted. (4) Nearsighted.

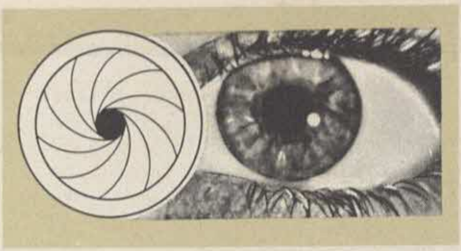
principles of physics and physiology.

Physiology of the Eye. The ball, or globe, of the eye is comparable with the camera box. It is made up of three coats: an outer, tough coat, the *sclerotic*; a middle, soft coat, containing many blood vessels, the *choroid*; and an inner coat, which is, in a sense, the expansion of the optic nerve, which passes back to the brain. This inner coat receives the impulses which result in vision. It is called the *retina,* and may be likened to the film or plate of the camera. The front of the eye is called the *cornea* and is part of the outer sclerotic, or tough coat. The middle coat is really made up of three parts: the choroid proper, the *iris,* and the *ciliary process.*

The iris gives the color to the eye and is seen through the cornea. In the center of the iris is the *pupil,* which admits light. The size of the pupil is controlled by two sets of muscle fibres in the iris. The ciliary muscle contròls the shape of the *lens* of the eye. In front of the lens is the *aqueous humor,* just behind the cornea; behind it is the *vitreous humor,* enclosed by the delicate *hyaloid membrane.* The aqueous humor, the lens, and the vitreous humor together compose the *refracting media* of the eye. At the upper and outer part of the orbit of the eye is found the *lachrymal gland,* from which tears flow and which also keeps the eye moist. The excess of flow is carried out in the tear duct to the nose.

How Sight is Produced. The eye is an organ of special sense, so constructed as to receive the stimulations of light vibrations. The eye does not itself see, but only receives sensations; it is the visual center of the brain, which sees. Light from an object of any kind is brought to a focus on the retina as an inverted image. From the retina, by means of the optic nerve, this image is transmitted to the vision center in the brain, where it is perceived in its proper position.

The refracting media mentioned above function by changing the direction of rays of light. Without such media, there could



IRISES: NATURAL AND MAN-MADE

be no clear vision. In addition, there is also the accommodation apparatus, by means of which the eye is able to adapt itself to objects at different distances. For far vision, where the rays are parallel, or nearly so, no accommodation (or focusing) is necessary; but for near vision such accommodation is constantly taking place in the normal eye.

This accommodation to different distances is brought about mainly by the ciliary muscle. When the eye is at rest, as in far vision, this muscle is relaxed and the lens is flattened somewhat, because a ligament, called the *suspensory* ligament, of the lens, is then taut. In nearer vision the ciliary muscle is contracted, a condition which slackens the suspensory ligament and allows the lens, which is naturally elastic, to bulge out or become more convex. Thus, by the relaxation or contraction of the ciliary muscle acting on the suspensory ligament on the lens, this elastic lens is rendered more or less convex, and rays of light from an object are accordingly brought to a proper focus on the retina.

Defects and Disorders of the Eye. Eyes may be nearsighted or farsighted, or they may be astigmatic. There may be certain defects in the eye, as in an optical instrument, which interfere with clear images on the retina and thus with good vision. In nearsight the eye itself is too long, and to bring about clear vision, concave, or diverging, glasses are required. In farsight the eye is too short and rays are brought to a focus behind the retina. Consequently, convex, or converging, glasses are required.

Where there are irregularities of curvature in the cornea especially, vision is indistinct because the vertical and horizontal curves are not the same. This condition produces astigmatism, and must be corrected, in simple cases, with cylindrical glasses or, in more complex cases, by certain combinations. If the lens becomes opaque, as it often does in old age and occasionally in children, then cataract is present, and can be cured only by surgery. Glaucoma and trachoma are serious eye infections that should receive prompt treatment. Many people become farsighted when they reach middle age.

For further information, see the following articles:

Blindness
Camera
Color
Lachrymal Glands
Lens
Light

EZE'KIEL. Author of the Old Testament book which bears his name, Ezekiel was a Hebrew prophet, the son of a priest, and lived on the shore of the Chebar River, in Mesopotamia. He began his prophecies concerning the fate of Israel about 592 B. C., and his predictions of horrors to come are probably based on first-hand experience, since he himself was taken prisoner by the all-conquering Babylonian, Nebuchadnezzar, in the capture of Jerusalem. Ezekiel's twenty years of prophecy are recorded in the book in two sections: chapters one to thirty-nine include prophecies before and after the destruction of Jerusalem by Nebuchadnezzar, and chapters forty to forty-eight contain the vision of Israel restored.

EZ'RA. The venerable Jewish scribe, Ezra, who lived in the time of the Babylonian captivity, is often called the founder of Judaism. It was he who, with the permission of Artaxerxes I, led a band of religious enthusiasts from Babylon to Jerusalem, where he preached his deep-rooted faith and brought new ideals and spirit to his downtrodden people.

Ezra was a scribe by profession, but of course he is also regarded as a preacher. His mission to Jerusalem took place about 458 B. C., when Nehemiah was governor of the city, and Ezra and Nehemiah are always closely associated. Tradition has it that Ezra lived to be 120 years old.

F. In the Phoenician alphabet, the letter *F* was used to symbolize a hook, or nail, but its appearance in those ancient days was quite different from the letter we know today. Then, it looked like this, 𐤅 , and it was not until the Greeks adopted it, about 500 B. C., that it began to assume its present form. It comes sixth in the alphabet, and is fourth in the musical scale of C. The sound of the letter *F* is produced by forcing the breath through the upper teeth as they rest on the lower lip.

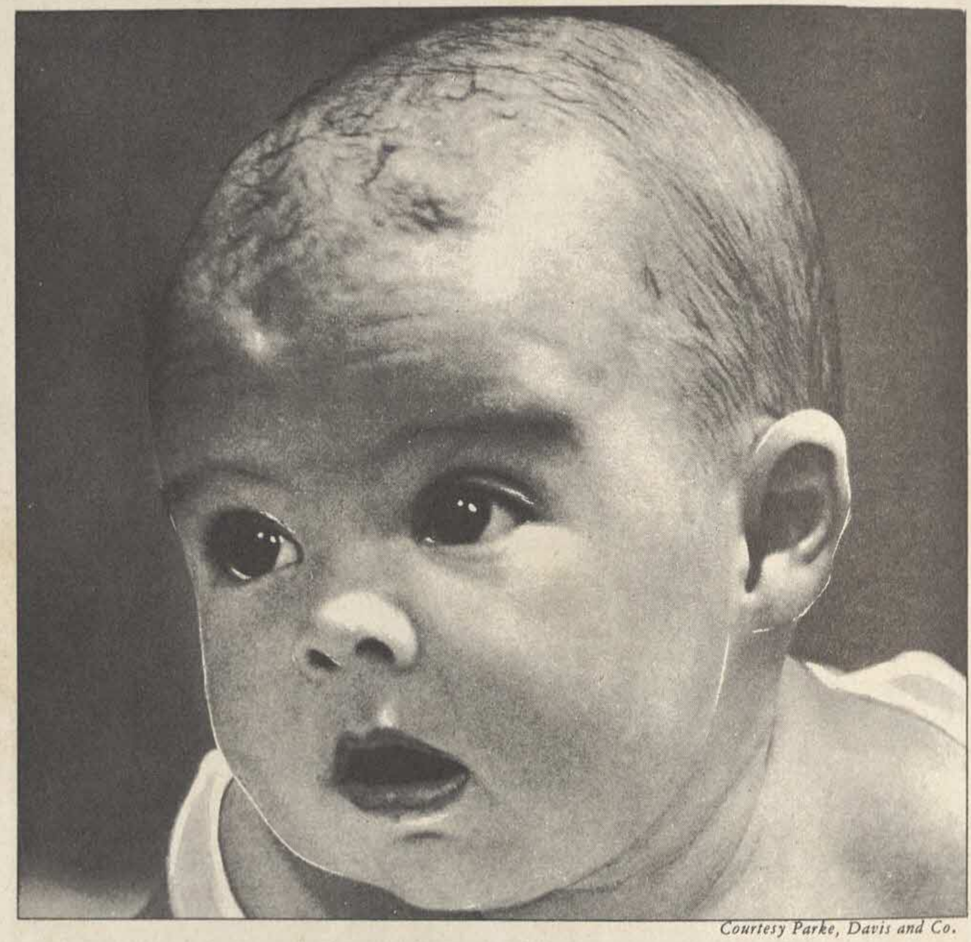
FA'BIUS. The name of Fabius has a place of honor through a long period of Roman history. Many generals, statesmen, and writers were members of that famous family. One of them, *Fabius Maximus,* leader of the army opposing Hannibal in the Second Punic War, gained for himself the title of the "Delayer" because he harried and worried the enemy, but avoided actual battle; his own army was too weak to make an attack. Such a policy of delay is known as "Fabian." George Washington was called the "American Fabius" because of his strategic retreats which deceived the enemy and gave him time to strengthen his own army.

FA'BLE. There is a little story, known to most of us from childhood, about a dog that crossed a bridge with a bone in his mouth. Looking down into the water, he saw his own reflection and thought he was seeing another dog. So he opened his mouth to snatch what he thought was the other dog's bone. Instead, his own bone fell into the water. The lesson, of course, is that those who try to get things that do not rightfully belong to them, usually lose what they have. In other words, it does not pay to be greedy.

This narrative is a fable, a kind of story that is meant to teach a useful lesson from the actions and conversations of its characters. In such stories the characters are usually animals who talk and act like human beings. The lesson taught, or moral, is not only apparent in the fable itself but is also given in a sentence at the end.

The first fables originated in Asia, but it was a Greek slave named Aesop, of the sixth century B. C., who is supposed to have created the best stories of this type. It is said that he used the fable to express his true feelings about the conditions of his times, since, being a slave, he was not allowed to speak freely. Little is known of him historically, and some writers think

MORAL: DON'T TRUST FLATTERERS
Crow tries to sing, loses cheese to fox.



Courtesy Parke, Davis and Co.

TIME WILL WRITE A STORY ON THIS IMMACULATE SLATE
Already the face of this charming baby expresses how he feels. Life will fix the marks.

there was no such man as Aesop at all. *Aesop's Fables,* however, are a valued part of the world's literature, regardless of their authorship. Among the well-known fables credited to Aesop are the following: *The Fox and the Grapes, The Lion and the Mouse,* and *The Ass in the Lion's Skin.*

FACE, *fase.* Although we seldom realize it, the fact remains that it is chiefly man's face that distinguishes him from the highest apes. For man, unlike all other animals, is able to talk and show expression because of the structure of his face. Truly the face is the most interesting part of man, for it is constantly changing in expression along with his feelings, revealing such emotions as joy, anger, and sadness. It is our face that largely distinguishes us from all other people, and reveals our true character. We come to know and love the faces and expressions of friends and members of our families.

Laughing and Crying. Of all the animals on the earth, man is the only one that laughs. Although everyone has his own peculiar laugh, the expression of the face in laughter is always the same. The corners of the mouth turn up and the eyes become squinted; this facial change seems to be the natural laughing expression, for even young babies look the same way when they laugh. There are several different kinds of laughter, ranging from the giggle to the hearty guffaw, and the sounds of each are produced by short, rapid contractions of the diaphragm.

Crying is very similar to laughing, and the sounds are so much alike that in many cases they can only be told apart by the expression of the face. The *lachrymal,* the tear gland, is an oblong body in the inside corner of the eye. This gland constantly secretes liquid, which flows down into the *lachrymal lake* located under the eyelid. Normally the lachrymal lake drains through two small canals into the nose, but when we cry, the gland secretes so much liquid that the lake cannot hold it all, and it overflows onto the face in the form of tears.

Blushing. Sometimes when we are embarrassed, our face becomes hot and flushed; that is, we blush. Blushing occurs when the blood vessels just below the surface of the skin become filled with an increased quantity of blood. This sudden flow of blood comes from the stimulation of certain nerves. Blushing is thus a nervous reaction. Sensitive and shy persons blush easily. We use the term *unblushing* in referring to people who are insensitive and hard.

Courtesy Link-Belt Co.

WHERE MEN AND MACHINES WORK TOGETHER

Factories are the foundation of the modern principle of production for the masses.

FACTORY AND FACTORY LEGISLATION. The great factories of today, filled with thundering machines and employing millions of workers, have developed since the last quarter of the eighteenth century. Before the invention of large and heavy machinery, goods were manufactured in the home, and only small, simple tools were used. When articles were produced by hand, only a small number could be made at a time, and it was difficult to distribute them to large markets because the homes of the workers were so widely scattered. In contrast to the modern factory system, in which the manufactured articles are the products of the joint labor of dozens of people, the hand method of production made it necessary for the worker to perform all the operations required to complete one article. This method tended to slow up production and consequently made the goods more costly.

In the modern factory system, several persons, each trained to a particular type of work, co-operate to produce an article. In this way a better commodity is produced in less time and at a saving of money and effort. The products of this system are just as good as those made by hand, and they can be purchased by the consumer at a great saving. While the factory is characterized by a large number of people operating complicated machinery, its fundamental feature is that the goods are produced by a division of labor.

The Growth of the Factory. The factory system originated in England in the second half of the eighteenth century with the invention of the spinning jenny by Hargreaves, the spinning frame by Arkwright, and the power loom by Cartwright. These machines could spin yarn and weave cloth much faster than could be done by hand, and machine-made goods soon supplanted those made by hand. The first factories were small buildings placed on the banks of swift-running streams, which furnished water power to turn the machines. Because water was at first the only source of power, factories had to be built in places where it was available; and, in many cases, they were far from the source of raw materials and markets. However, with the invention of the steam engine, factories could be located near the source of supply and large markets.

Another development that greatly aided the growth of the factory system was the improvement of transportation facilities. Whereas, at first, manufacturers could sell their goods only in limited areas, after the development of the railroad and the steam vessel, goods could be shipped to markets in parts of the world before inaccessible.

When the first machines were built, the workers looked upon them with suspicion, thinking that machinery would cause them to lose their jobs, and in many cases machines were destroyed by irate mobs. After a period of adjustment, the new order was accepted. The factory system was greatly stimulated by needed legislation, for patent laws protected the inventions against duplication, and the inventor was able to profit by his work.

The beginning of the factory system in the United States dates from 1790, when Samuel Slater set up a small textile factory in New England. At that time the English government would not allow any of the plans for machinery to be taken out of the country, in order to keep other nations from developing competing industries that might harm those of England. Thus Slater was forced to memorize the plans for his machinery when he left England for America. Up to 1840, American industry had a slow growth, but by that time there was a large enough population to man the factories and to buy their products.

Effects of the Factory System. The factory system has had both favorable and undesirable effects in relation to workers and the consuming public. The advantages are readily seen. By means of mass production, a large quantity of goods can be produced at less cost, with resulting lower prices. If automobiles were made one at a time, the cost of materials and labor would be so high as to make their price prohibitive; but when large numbers of cars are made in a day in a single factory, by means of laborsaving machinery and a division of labor, they are brought within the means of a correspondingly large number of buyers.

The low price of goods leads to an increased demand on the part of consumers, and this demand, in turn, increases the number of jobs for workers and raises wages. The higher wage means a higher standard of living for the population, and creates markets for a greater variety of products. Thus, at its best, the factory system is one of the most important aspects of modern life; upon it depend prosperity and a high standard of living.

In its earlier development, however, the factory system brought about many evils. The installation of machines requiring no particular skill or intelligence, and the fact that one machine could do the work once performed by many men, tended to create fewer jobs and to reduce the wage level. Workers were forced to live in crowded, unsanitary tenements, a condition that gave rise to many social problems difficult to solve. Many factories themselves were unsanitary and poorly lighted. Another evil was the employment of women and children at long hours and low wages.

Factory Legislation. Along with the development of the factory system has come the increase of labor laws. Passed by both state and Federal governments, these laws have had the purpose of improving working conditions. Several of the states have passed laws prohibiting the employment of children up to the age of fourteen. An amendment to the Constitution prohibiting child labor has been proposed, but it has not yet been approved by the required number of states. The employment of women in factories is prohibited by some states and limited by others, but almost all states have laws limiting the hours of work for women.

Many of the labor laws directed toward the improvement of working conditions require that factories be adequately lighted, be kept clean, and that the workers be protected against injury by guards on the moving parts of machines. A majority of the states have a department of government devoted to the inspection of factories and the prosecution of all those that violate the labor laws.

Today great numbers of factory workers belong to some sort of labor organization. In fact, labor unions have been largely responsible for the passing of many of the laws pertaining to labor.

Congress has passed laws setting minimum wages and maximum hours of work and establishing the right of employes, including factory workers, to unionize and to bargain collectively with their employers. Other Federal legislation has provided for retirement benefits and unemployment compensation. Laws affecting factory workers and management throughout the United States include the National (Wagner) Labor Relations Act, the Social Security Act, the Fair Labor Standards Act, and the Labor-Management Relations (Taft-Hartley) Act. Most other industrial nations also have their factory legislation.

For further information, consult the following articles:

Child Labor
Industrial Revolution
Labor Legislation
Labor Organizations

FAHRENHEIT, *fah' ren hite,* GABRIEL DANIEL (1686-1736). When we read on the thermometer that the temperature is 50 degrees Fahrenheit (50° F.), we are honoring the man who perfected our present scale for measuring temperatures. Gabriel Daniel Fahrenheit was a German physicist who manufactured meteorological instruments. He found that a better thermometer could be made by substituting mercury for alcohol in the glass tube, and then worked out the Fahrenheit scale for measuring the degrees of temperature. See TEMPERATURE; THERMOMETER.

FAIR. Fun and frolic, shows and exhibits, and all sorts of interesting things go to make up a modern fair; for the fair has come to be a place where goods are exhibited and people have a gay time. Once, however, fairs were really large markets, conducted periodically, where people came from near and far to buy and sell the wares displayed. In the Middle Ages they were very important and were supported by the nobles and magistrates, who saw that they were opened and conducted with due ceremony.

Modern distribution facilities have lessened the need for large temporary markets. They have been replaced by small bazaars, exhibits, and money-making carnivals, often termed fairs. Almost all states conduct annual livestock, agricultural, or industrial exhibits, or fairs, which are usually accompanied by horse races, rodeos, judging contests, or other entertainment.

DREAMLAND'S LOVELY PEOPLE

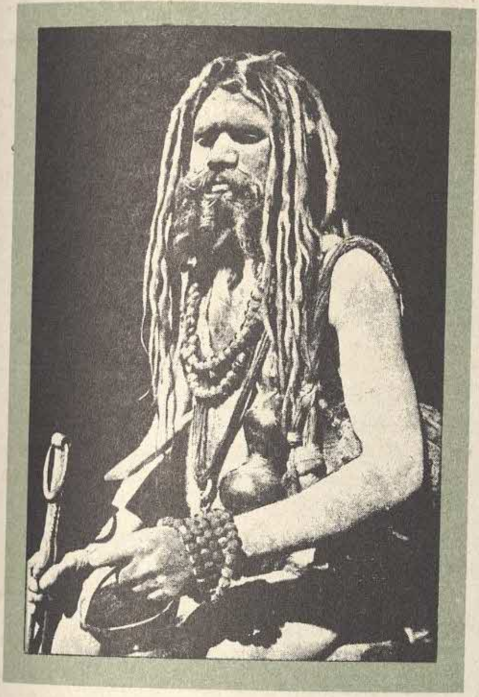
Fairies—carefree creatures whose Never-Never Land lies close in the hearts of children. These scenes are from a German fairy tale.

In Europe, fairs still retain in many ways the ceremony and atmosphere of the past. Among the most important of the fairs regularly held today are those at Lyons, France, at Leipzig and Frankfort-on-the-Main, in Germany, at Gorki, in Soviet Russia, and at Hurdwar in India. However, great international expositions, termed world fairs, are held in major cities in both Europe and America.

FAIRIES. Even though fairies live only in our imagination, the lover of beauty and nature delights to people the fields and woods with these fascinating creatures. Glistening, pearly droplets of dew arranged like jewels on the strands of a spider web could only have been placed there by some dainty, tiny being, we fancy. And during the fall, when the green leaves turn to scarlet and bronze, it seems that only an elfin brush could have touched each leaf with its magic color.

But we need not lament the fact that fairies are not real. They do live—in books, and plays, and poetry; and on the printed page we find them very much alive, performing miraculous feats with their wands, and living through wonderful adventures that we all enjoy. Not all these fairies are graceful little maidens with golden hair and silken wings. Some of them are old, like Cinderella's godmother, and others are witches who can be seen riding their broomsticks on Hallowe'en. Still others are little boys like Peter Pan, who has his shadow tacked to him; and Puck, who delights in tantalizing the poor mortals who venture into the woods on a midsummer night.

Some of them are little old men called *gnomes* and *dwarfs,* who guard the treasures of the earth and might do us mischief if we doubted their reality. Other fairies live in the water and are called *nixies.* Lorelei, who lured men to destruction on the rocks, was one of these nixies. *Undines,* too, are water spirits. An undine receives a soul if she marries a mortal and bears a child. Ireland is the home of the *pixies,* who receive the souls of unbaptized chil-



INDIA'S "HOLY" BEGGAR
Thousands of fakirs seek alms all their lives.

dren who die. *Banshees* in Scotland can be heard in homes where a loved one has died, for they weep and wail when death occurs. Beautiful, but sad, is the life of the *peri* in Persia, for these fairies, who live on perfume, try to go to heaven by performing good deeds; but, alas, they cannot, for they have no souls.

Each land has its favorite fairies. The children of America are fond of *brownies* and *kewpies.* Russian fairies wear furs; while Chinese fairies have long queues down their backs.

Some of the most familiar fairies may be found in Grimm's *Fairy Tales;* in Shakespeare's *A Midsummer Night's Dream,* and also in his Queen Mab passage in *Romeo and Juliet;* and in books by Hans Christian Andersen.

FAIRY RING. Sometimes we find, on a grassy lawn, a perfect ring where the grass is very much greener than that around it. This is a fairy ring, so-called in legends because it was believed to mark the spot where fairies had gaily danced. Actually, it is caused by a fungus growth which has decayed and fertilized the ground, making the grass more luxuriant and green.

FAKIR, *fa' kur.* In the Far East, especially in India, a Moslem who takes up a life of meditation and poverty is called a *fakir,* an Arabic word meaning *poor.* The term is also applied to fanatics of other faiths. Some fakirs live in communities, devoting themselves to severe religious discipline. Others live in seclusion or as wandering beggars, who torture themselves physically to convince others of their holiness.

FALCONRY, *faw' kun ri,* **or HAWKING.** When princes lived in castles and firearms were unknown, falconry was a favorite pastime among the nobles. Strong, powerful, sharp-clawed hawks, known as falcons, were trained to seize and return prey, and, as a sport, it was unexcelled during the Middle Ages.

Falconry still exists as a pastime in England and other countries, but it is not nearly so prevalent as it was five or six centuries ago. Then, forests surrounding the feudal estates of lords and princes would resound daily to the shouts and laughter of the hunters as they made their way among the trees in search of game. The falcon perched on the shoulder of its master and was hooded. At intervals, the hood was removed, and the bird would soar aloft in search of prey. Spying it, the falcon would circle and swoop down, seizing the animal with its sharp talons, perhaps killing it with its pointed, curved beak, and then return it to its master.

Some monarchs, like Henry the Fowler and Emperor Frederick II, who made the sport a hobby, maintained a large corps of men whose duty it was to train and take care of the falcons. In their courts the position of grand falconer was an honored one. Today, the sport is still carried on in much the same manner as it was years ago, but the number of participants is far less.

SPORTING BIRD
For hundreds of years, falcons have been used by hunters to catch other birds. These powerful hawks are trained to capture the prey.

FALKLAND, *fawk' land,* **ISLANDS.** In the South Atlantic, about 300 miles east of the Strait of Magellan, lie the Falklands. A British crown colony, the group consists of two large islands, East and West Falkland, and many smaller ones, having a total area of 4,618 square miles. About half of its some 2,500 inhabitants live in Port Stanley, its capital.

The cool, wind-swept Falklands are hilly, rocky, bog-dotted, and treeless. But from the sheep grazed on their native grasses come wool, meat, hides, and tallow for export; from their surrounding waters, whale oil and sealskins. They are, however, chiefly important as a naval station and as an administrative outpost for the British-controlled Falkland Islands Dependencies, as the land areas of a vast surrounding stretch of sea are called.

Discovered by John Davis, an English explorer, in 1592, the Falklands have been British-occupied since 1833. In 1914, in one of the chief naval battles of World War I, British ships destroyed Germany's Pacific fleet near their coasts. Argentina still denies British claims to the islands and the dependencies.

FALLING BODIES. If a stone and a feather are dropped at the same time, the stone reaches the ground sooner than the feather. The stone's speed is not due to its greater weight but to the fact that the resistance of the air does not retard the stone as much as it does the feather. In a vacuum, stone and feather fall at the same speed.

Bodies fall because they are drawn toward the center of the earth by gravitational force, which is very nearly constant over the surface of the planet. See GRAVITATION.

A nut dropping from a branch will hit ground sixteen feet below, in one second. Although it has a velocity of 32.16 feet per second at the moment of hitting, it starts the second with no velocity at all and therefore averages 16.08 feet per second. If the branch were sixty-four feet high, the nut would not be four times as long in falling, but only twice as long, for its average speed during the second second would be halfway between 32.16 and 64.32 feet per second, which is 48.24 feet per second—and it would fall three quarters of the distance in the second second. Here, as in all cases, *the distance fallen is proportional to the square of the time of the descent.*

Rising and Falling. Any projectile that is shot straight up will return to the earth with practically the same velocity as it had when it left the gun. The height reached by a bullet depends upon the velocity it has when it leaves the gun. The acceleration of gravity is the same in a body whether it is moving up, down, or sideways. The bullet that is shot straight up loses its velocity at the rate of 32.16 feet per second in every second whether its speed is high or low.

A rifle bullet with a muzzle velocity of 3,216 feet per second would keep on rising for 100 seconds. Then it would turn and hit the earth 100 seconds later, with a velocity of 3,216 feet per second. A projectile that is shot in a horizontal direction from a height of five feet will hit the ground at the same time as a stone dropped from a height of five feet at the instant the shot is fired.

In all these problems, the retardation due to the air resistance is not considered. For small distances heavy objects fall with practically no retardation. For high-speed projectiles traveling great distances, the air resistance becomes so large that it must be taken into account in making calculations.

FAM'ILY. In all its various uses, the word *family* carries the idea of a group of individuals having some common relationship. The term brings to mind, first of all, that closest of human associations—the family consisting of father, mother, and children. In botany and zoölogy, the family is a group classification of related plants or animals which is higher in rank than the genus. The tiger, lion, and domestic cat all belong to the family *Felidae;* the lilies, tulips, and hyacinths are members of the family *Liliaceae.* The term has an even wider application, for we speak of certain musical instruments as belonging to the woodwind family, and we apply family names to groups of printing types, chemicals, and many other materials or objects.

The Human Family. Since man ceased to be a nomad hunter, when he never cherished one home, one mate, or a lifelong association with his children, the human family has been an important factor in the development of man as a social being. Beginning as a self-sufficient economic unit, a means of security, defense, and companionship, the family was at first the community and state, all in one. As life became more difficult and the struggle for survival became keener, families gradually grouped together to form communities, and communities to form states. The family then became the primary source of education and of moral and spiritual development for its children.

Today, despite the increasing importance of the community, church, and school interests, it is still the place where the training of children begins. In modern society, the family provides for its members food, shelter, clothing, and the needs common to all mankind. It is the heart of companionship, recreation, and culture—truly the basic unit of organized society.

The Family in the Community. If the culture of a community is low, usually it reflects the family life in that community. For, in society as it is now organized, whatever contributes to a sound, happy, and secure family is desirable for the community. Whatever tends to destroy the family is the enemy of the community, since the community is made up of families and is closely identified with its individual parts. When the family becomes weak, the community life starts to crumble; that, in turn, reflects on the security and stability of a nation, and eventually reaches the heart of the civilization. Western civilization, as we know it, is a product of a family life based on monogamy, with one couple forming the center of the family. Other more complex family relationships—more than one wife or more than one husband—have proved less satisfactory.

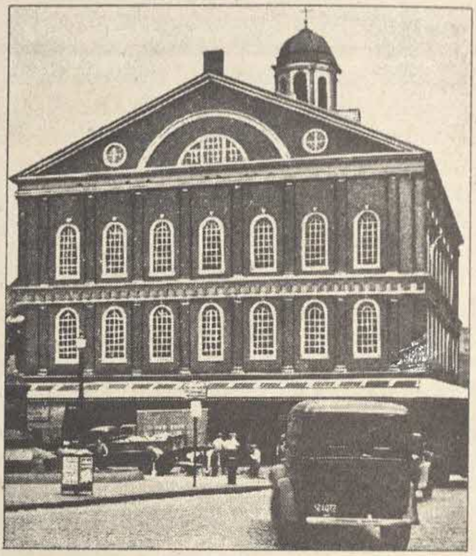
Division of Labor. Traditionally, the rôle of man and woman in the family has been one of a division of labor, where the father has supplied the shelter and means of livelihood and the mother has assumed the upkeep of the home and the care of the children. There the children develop the elements of honesty, affection, understanding, sympathy, kindness, unselfishness, and the many other qualities which mold the character of men and women. When the two parents in some way fail in their obligation, they multiply their failure often at least threefold, for out of one single family are produced the other possible families of the children.

Homes which are not happy or which have been divided by various causes produce marked social problems in maladjusted and unhappy children. Sometimes the state is the only means of continuing the home life of the individual. Even though worthy charity agencies and the state may do their best, they may fall short in giving the individual care and attention that the normal family should provide.

FANEUIL, *fan' el,* **HALL.** One of Boston's many historical buildings is Faneuil Hall, long called the "Cradle of American Liberty." A square, brick structure, it is not particularly imposing, but from 1742 its walls repeatedly echoed the voices of America's great men, raised in the cause of liberty. It was originally built as a public market by Peter Faneuil and given to the town. The structure burned in 1761, was rebuilt in 1763, and was dedicated by James Otis, in a stirring address. Later, the Boston Tea Party was organized within its walls.

After the Revolution, Faneuil Hall still retained its position as a meeting place for important gatherings. In 1837 Wendell Phillips made his first anti-slavery speech at a meeting in memory of Elijah Lovejoy, a victim of mob violence at Alton, Ill.

A provision of the donor, Peter Faneuil, was that the hall could not be rented, but could be used for any purpose approved by the town aldermen. Although built by private funds and at best only a small town hall, because of the freedom of thought which found expression there, this structure in the heart of Boston's old market place ranks as one of the nation's foremost patriotic shrines. See BOSTON.

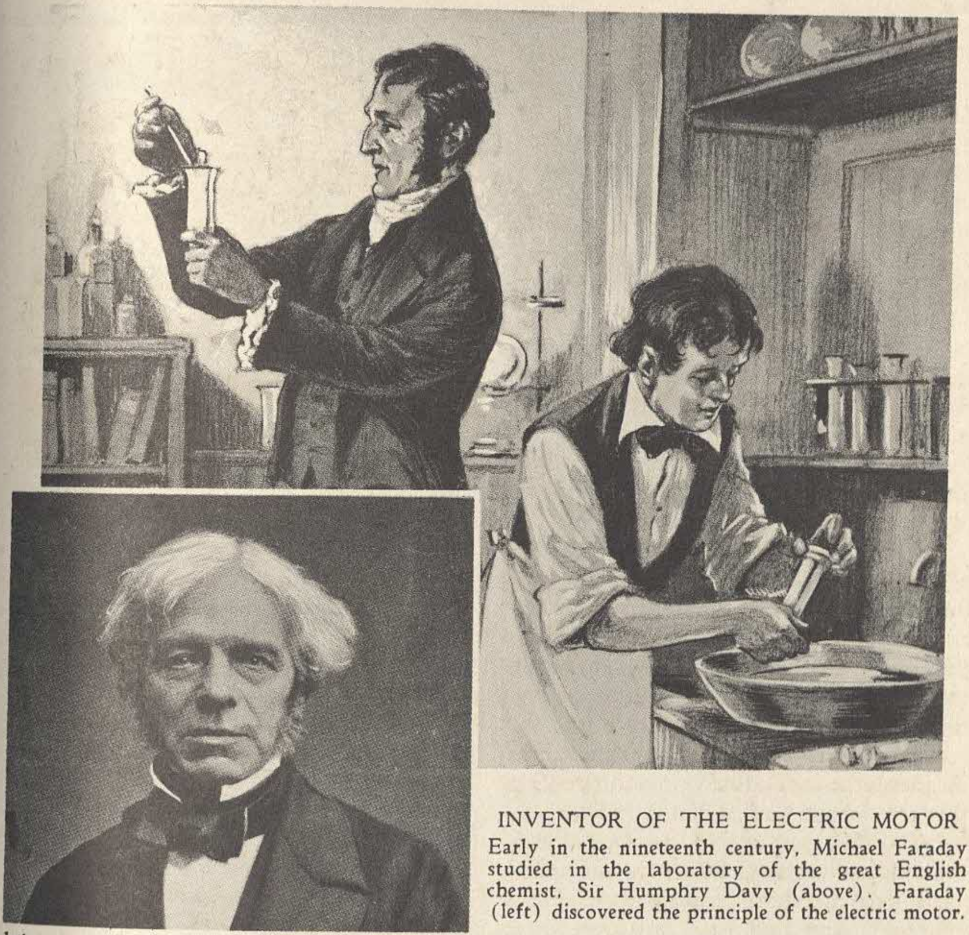


AMERICA'S CRADLE OF LIBERTY

Faneuil Hall, scene of the mass meeting in 1773 at which the Boston Tea Party was organized. It was built in 1742 as a gift to the town.

FARADAY, *fair' a day,* MICHAEL (1791-1867). One of the greatest chemists and physicists who ever lived, Michael Faraday undertook the tremendous task of making electricity the servant of man. He produced electricity from magnetism and found how electricity could turn wheels. This discovery led to the invention of the dynamo, the machine which converts water power into electric current to operate great factories and to light whole cities. Faraday's experiments with hydrogen and carbon brought about the discovery of benzene, the most important factor in the preparation of aniline dyes.

The son of a poor blacksmith, he had little schooling, being sent to work for a bookbinder at an early age. However, his



INVENTOR OF THE ELECTRIC MOTOR
Early in the nineteenth century, Michael Faraday studied in the laboratory of the great English chemist, Sir Humphry Davy (above). Faraday (left) discovered the principle of the electric motor.

leisure moments were spent in reading scientific books and conducting, with crude devices, experiments in electricity. He attracted the interest of Sir Humphry Davy, the famous chemist, who had him appointed as his assistant at the Royal Institution in London. Faraday remained fifty-four years with the Institution, rising to the rank of professor of chemistry. While there he conducted his most famous experiments in chemistry and with electricity. Among his important publications in science are: *Experimental Researches in Electricity, Lectures on the Chemical History of a Candle,* and *On the Various Forces in Nature.* See MAGNETISM; ELECTRICITY; DAVY, SIR HUMPHRY.

FARM BOARD, FEDERAL. See FARM RELIEF.

FARM CREDITS. See RURAL CREDITS.

FARMERS' ALLIANCE. See POLITICAL PARTIES IN THE UNITED STATES.

FARM RELIEF. It has been said that the farmer is the backbone of the United States. When he produces good crops and sells them at a fair profit, the prosperity of the nation is increased because the farmer then has money with which to purchase manufactured products from industrial centers. A large percentage of the population lives on American farms; for this reason political parties and Congress find the problems of the farmer a matter of grave concern. For many years the farm bloc has

IN THE DAY'S WORK ON THE FAROES
It's a hardy Norse race that lives on the islands of the midnight sun. Above, the catch—hauling in a whale. Right, launching a boat.

been an influential factor in Congress, and various laws have been passed granting protection and relief for agriculture.

For years American farmers enjoyed the benefits of high tariffs levied on foreign products. Such protection served to keep up the market prices of home products; and, because of low tariffs (or none at all) elsewhere, American farmers were able to sell in foreign markets. In recent years, however, other nations have placed similar tariffs on American goods. The increased foreign tariffs cut off the farmer's market abroad, and the surplus left on his hands caused the home market prices to fall. Consequently, farm relief became a pressing problem.

The Federal Farm Board was established in 1929 during the administration of President Hoover. The purpose of the board was to place agriculture on an equal basis with other major industries by preventing waste, decreasing speculation, and encouraging co-operative organizations. During 1930-31, when the markets declined, the government purchased and stored surplus crops to retain a high market price. The Farm Credit Administration replaced the Federal Farm Board in 1933. Among other services, it has refinanced thousands of farm loans a year, enabling farmers to retain their homes and buy new seeds for crops.

As it was during President Hoover's administration, farm relief was a problem when President Franklin D. Roosevelt took office. Foremost in the Roosevelt program was the Agricultural Adjustment Act

(A.A.A.) passed by Congress in 1933, which provided for agreements to be signed by farmers. Those farmers who agreed to reduce production, thus decreasing the supply and raising the market price, were guaranteed subsidies by the government. The Supreme Court, however, declared the act unconstitutional in 1936 because it delegated to Congress powers not provided for in the Constitution.

Shortly after this action by the Supreme Court, Congress acted to pass revised laws intended to help the farmer. Thus there came into effect the Soil Conservation and Domestic Allotment Act. It provided for the preservation and improvement of the soil; promotion of careful use and conservation of land; stoppage of wasteful use of soil resources; protection of rivers and harbors against erosion, thereby aiding flood control; and the gradual increase in the farmer's purchasing power. The government further aided through marketing surplus crops, giving crop insurance, and providing a co-ordinated rural credit system.

FAROE, *fa' ro,* **ISLANDS.** Between Iceland and the Shetland Islands in the North Atlantic lie these Danish Islands of volcanic origin. Their name in Danish means *sheep islands* and is descriptive of the major industry. The natives, descendants of Norsemen who came in the ninth century, also engage in whaling, fishing, and bird hunting. They are friendly and quiet people who cling to old traditions and speech.

There are twenty-one islands, of which seventeen are inhabited. The area of the group is 540 square miles, and the population is about 30,000. The steep-coasted, hilly Faroes, whose capital is Thorshavn, on Stromö Island, have belonged to Denmark since 1387. They send three delegates to the Danish Parliament and have a governor appointed by Denmark's king. They have long elected their local assembly and have had home rule since 1948.

In April, 1940, following the invasion of Denmark by Germany, Great Britain occupied the Faroe Islands as a precautionary measure against German establishment of air bases. The occupation was for the duration of the war.

FAR'RAGUT, David Glasgow (1801-1870). As the most able naval commander of the Civil War, David Farragut won an early victory in the capture of New Orleans in 1862. He also gave valuable aid to Ulysses S. Grant when that officer took Vicksburg; and he crowned his achievements in 1864 by inflicting a decisive defeat on the Confederate fleet in the Battle of Mobile Bay.

When his father, a Revolutionary War soldier, died in 1809, Farragut was adopted by a naval commander, David Porter. He became a midshipman at the age of nine, and when twelve years old was made prize-master of a captured English vessel in the War of 1812. He served with distinction during the Mexican War, and then was assigned for four years to the Mare Island Navy Yard near San Francisco. At the end of the Civil War, in recognition of his great services, Congress created for Farragut the rank of admiral.

FAR'THING. The smallest of English coins, the farthing is worth one fourth of a penny. Since 1860 it has been made of bronze, but originally a farthing was one of the parts of a silver penny broken into four pieces. In the reign of Charles II, copper farthings were issued. In Bible times, two small Roman coins also bore this name. In *Luke* XII, 6, occur Christ's words: "Are not five sparrows sold for two farthings, and not one of them is forgotten before God?"

NOT WORTH A PENNY
The farthing, smallest of English coins, is worth only a quarter of the value of the broad English penny. This is a Queen Anne coin.

FASCISM, *fash' iz'm.* This political philosophy was first developed under Benito Mussolini, dictator of Italy between the two World Wars. The name is derived from the Roman *fasces.* The fasces were bundles of rods bound together, which were carried in advance of the Roman magistrates. Usually an ax extended from the middle of each bundle; the rods were symbols of the power to punish by flogging, and the ax indicated the power to punish by death.

Fascism reached the zenith of its influence during the Second World War, and went into eclipse with the defeat of the Axis in 1945. Italy and Germany were the leading Fascist states; after their surrender, Fascism lingered, chiefly in Spain and Argentina, and remained a serious problem in many other countries.

Modern Fascists believed that they themselves symbolized the power of the state, and expressed their purpose in these words: "Society is the end, individuals the means, and its whole life consists in using individuals as instruments for its social ends."

In practice, Fascism was more realistic than many other forms of government, for what the dictator wanted, he attempted to do. Under Mussolini, the capitalistic system, private property, and private means of producing goods were favored so long as they did not interfere with the advancement of the state. In its final development, the Italian Fascist organization became a *corporate state,* a form of state capitalism in which the agricultural, industrial, and professional branches of the economic set-up were united in twenty-two corporations.

At one extreme of the governments in the period between the two wars was communism as practiced in Russia, a system based on the supremacy of the working class and the abolition of private property.

The middle ground was representative democracy, which favors private property with special emphasis on individual freedom and liberty. The United States and Great Britain are democracies in this sense. At the other extreme were Fascism and Nazism, seeking a powerful state under the control of the property-owning classes. Although they had different objectives, the means used by both Fascism and communism were similar. Members of a small group identified themselves with the state and ran affairs in a manner which they believed was for the best interests of the people as a whole.

Fascism, Nazism, and communism, as practiced, had a common weakness in that they were dependent on one leader or dictator who could not easily be replaced. All four countries—Italy, Germany, Russia, and Spain—resorted to restrictions on free speech, the press, elections, and personal freedom, in order to achieve their purposes. See HITLER, ADOLF; MUSSOLINI, BENITO; NAZISM; RUSSIA; SPAIN; STALIN, JOSEPH.

FASTS AND FASTING. Abstaining from food, or fasting, is frequently undertaken in clinical experiments to give scientists an opportunity to study its effects on the human body. Medical research has established that ordinary human beings cannot live very much longer than eight days without eating, but there are records of exceptional cases of longer periods of fasting. People are very close to death when they lose four tenths of the normal weight of their bodies. Death comes sooner when the body is deprived of water as well as food. Short fasts are sometimes recommended as cures for digestive troubles.

Certain animals have been known to exist without nourishment a good deal longer than eight days; sometimes for several weeks, in the case of dogs and cats, and several months, in the case of hibernating animals like bears.

Fasting is a time-honored religious observance with many races. During the entire Mohammedan month of Ramadan, the faithful fast during the daylight hours. Orthodox Jews have several fast days, the principal one being Yom Kippur, the Day of Atonement. Fasting is common in Christianity, also; forty-eight days of partial abstinence are prescribed in the Greek Church at Easter time, thirty nine at

Christmas. The principal Roman Catholic fasts are the period of Lent, preceding Easter, and several designated days. See ABSORPTION; DIET; DIGESTION; FESTIVALS.

FAT. When we speak of a horse carrying too much fat, or of a piece of salt pork that is a "strip of lean and a strip of fat," we are thinking of a certain kind of body tissue which may also be referred to as *adipose* tissue. But when we say that a cow has produced 800 pounds of fat, we do not mean that she has added that much adipose tissue to her body, but that her milk production for a certain period has contained 800 pounds of the chemical substance which is found inside the cells in body fat. In both senses of the word, fat is an important substance.

With fat as a chemical substance we are concerned because of its place in our diet. The most common food fats are butter, lard, fat meat, vegetable oils, and cream. Perhaps it is not so generally known that when we eat cheese, milk, eggs, olives, nuts, piecrust, and chocolate, we also get considerable fat. Of the fruits, olives have the highest percentage of fat by weight—about twenty per cent. Lards and oils are a hundred per cent, butter is eighty-five, and many nuts fifty per cent.

Fats contain the same elements as sugar and starch, the carbohydrates—carbon, hydrogen, and oxygen—but the elements occur in different proportions. All fats have practically the same fuel or energy value whether liquid or solid, highly flavored or bland. Fats are either burned in the body to furnish heat and energy to do our work, or they are stored as body fat, if eaten in excess of our needs. When they are burned completely, the waste products are carbon dioxide and water. Fats yield more than twice as much fuel, weight for weight, as carbohydrates. Their place in the diet is very important, but they should not be eaten in excessive amounts. See DIET.

Most of the important liquid fats are described in this work in the article OILS. Of the solid fats important in commerce, nearly all those of vegetable origin come from the tropics. Palm oil, cocoa butter, coconut oil, and vegetable tallow, from the tallow tree, are widely used in cookery or in industry. Animal fats come from beasts and birds of the temperate zones. With the exception of butterfat, in milk, they are all body fats. Tallow, the hard, white fat of sheep and cattle, is used in making soap, candles, and lubricants. Beef tallow is employed in making oleomargarine, a butter substitute.

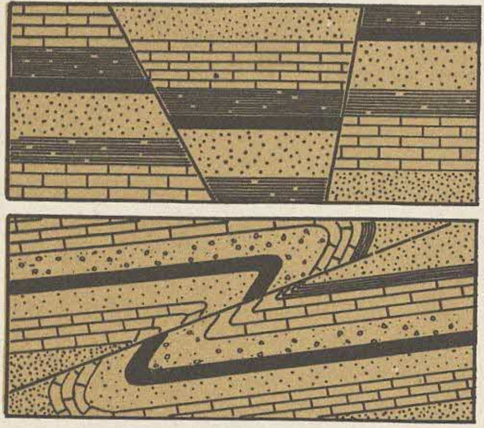
FATHOM, *fath' um.* Equal to six feet in length, the fathom is used in measuring the depth of water by sounding; also in measuring the length of cables and cordage. A *cable's length* is 120 fathoms, or 720 feet. The fathom was originally considered to be the stretch or reach of a man's two arms when fully extended, in pulling in the lead line, and was five or five and one-half feet.

FATIGUE, *fa teeg'.* When a person says, "I'm tired," he may well have said, "I'm fatigued." He means that his body does not have the vigor that is present when a person is in good health and has had sufficient rest. Continued reading may fatigue the eyes, or long walks may tire the legs. Extended use or great strain of muscles and nerves causes them to seek relaxation, and the individual is warned by a tired feeling that it is time to rest.

The effects of physical and mental fatigue have long been studied by doctors and psychologists. They believe that the tissues of the brain are more resistant to fatigue than are the body muscles. Like a stove which burns coal and gives off ashes and smoke, the body burns energy and gives off waste products to the blood stream, which carries them off. At times when muscles are working under strain, waste matter is produced faster than it can be removed, and the muscle tissues become clogged and "tired." Healthy persons withstand fatigue better than ill-nourished, weak people, because the blood of the latter does not work so effectively in waste removal. Continued fatigue without rest will injure health.

Modern industry has found that employes work better when not over-fatigued. Studies have been made of the effects of fatigue in industry, and many factories now provide rest periods and recreation hours during the work schedule.

Fatigue of Metals. Strain on metals produces fatigue, or weakening, which, if continued, will cause the metal to break. If a piece of wire is bent backward and forward, the place where it is bent will become fatigued, and eventually the wire will break at that point. A variety of stresses can weaken metals, such as bending, strain, shock, or excessive use of certain portions. It is estimated that eighty per cent of the failures in modern engineering efforts are produced through metal fatigue.



KEY TO EARTH'S HISTORY
Fractures in strata of the earth's rock often cause earthquakes, furnish clues to structural changes taking place underground. Top, gravity fault. Below, thrust fault.

FAULT. Fracture planes in rock formations are faults, along which the rocks are dislocated. Sometimes faults are simply fissures, the walls of which are *slicken-sided* (polished in sliding) by the movement. Sometimes the rock is broken and crushed by the dislocation, and a *fault breccia* is produced. Earthquakes are often caused by sudden movements along faults. After the San Francisco earthquake, faults of several feet were found. They broke the water mains in the city and left it without adequate fire protection.

DEMI-GOD OF THE WOODS
The Faun, as carved by Praxiteles.

In coal and other mines, faults often break across veins being worked. In such cases, it is necessary to move a gallery up or down, as the angle of the fractured rock strata may dictate. See EARTHQUAKE; GEOLOGY.

FAUNS. Almost everything in the world of the ancient Romans was believed to be controlled by some sort of god, and the half-divine beings who inhabited the forests and woods were called *fauns*. Though hardly the gay creatures of later fairy tales, fauns were thought to be of a pleasant character, and usually whiled away their days playing ditties on a set of mouth-pipes.

According to mythology, they were represented as men, often with a pair of horns, and sometimes with a goat's tail and cloven feet. These odd inhabitants of forest vales have been the subject of many stories, and of the sculptor's art. The best-known of these statues is the marble faun in the Capitoline Museum at Rome, supposed to be the work of Praxiteles. Nathaniel Hawthorne's novel, *The Marble Faun,* was based on this statue.

FAUST, *fowst,* JOHANN (about 1485-about 1540). The most famous of all the mystic medieval astrologers was Johann Faust, a learned student of magic whose career has been made immortal by a wealth of accumulated legend. The historical Faust was a German scholar who, like other astrologers of his day, dealt chiefly in weird incantations to the devil and the spirit world in general. From there the legend takes up the tale, and makes the name Faust one of the most prominent in literature.

The first to dramatize what was thought to have been the life of the astrologer was Christopher Marlowe, a brilliant English playwright and contemporary of Shakespeare. This play, like others that followed, says that Faust first studied for the ministry, but abandoned this pursuit for the field of magic. His studying, in the German city-state of Wittenberg, continued until he became an old man, obsessed with the idea of regaining his youth. He succeeded in persuading the Devil to grant his desire, but he had to promise the Evil One his soul when he died.

The Devil gave him his youth, and the happy Faust fell in love with the beautiful Marguerite. His romantic career was brief, however, and soon Faust realized that he was about to die. According to their bargain, the Devil came to take Faust's soul. Marlowe's lines, in which Faust in his extremity begged for mercy, form one of the greatest examples of blank verse in all English literature. Faust's eloquence, however, was of no avail.

The fascinating theme and dramatic events of the story were the inspiration of several writers. The great German poet Goethe wrote a famous dramatic version of the tale. He added considerable detail, so that his play probably ranks as the best of the Faust stories. From the Goethe work the composer Gounod created an opera of the same name which is still among the favorites of music lovers.

FAWKES, GUY. See GUNPOWDER PLOT.

FEASTS. See FESTIVALS.

FEATHERS. One important thing birds have, and share with no other living creatures, is feathers. The soft fluffiness of the down on a bird's breast makes it difficult to realize that feathers are composed of the same substance as horns, hoofs, and fingernails—dead tissue.

All the little branches of a feather, those that can be seen with the unaided eye and those discerned only through the magnifying glass, are complete before they emerge from the little, moundlike gland which is the base of the feather.

The structure of feathers is surprisingly intricate. A feather has two main divisions —a *stem,* or *shaft,* and a *web,* or *vane.* The stem consists of the *barrel, quill,* or *calamus,* hollow in its lower part, and in its upper part furrowed on one side and filled with pith. This furrowed part is called the *rachis.* From it grow pairs of little, obliquely directed branches, called *barbs,* which are united to form the vane. The barbs appear as though they, too, were tiny feathers, for they bear little branches, called *barbules,* which are so small that there may be a million on one feather. And the barbules in their turn have minute branches, or *barbicels.*

These tiniest branches of all, though on most feathers so small that they cannot be seen without a magnifying glass, may have at their ends wee hooks. These hooks, called *hamuli,* are near the tip of the feather. They catch on the barbules of the adjoining feathers and make a continuous web. When the little hooks are lacking, each feather is independent of its neighbors, and is said to be fluffy or downy. Young birds are covered with soft down before they develop their regular coats. Ducks and other water birds, who need it for warmth, have down beneath their hooked feathers.

The *pin* feathers which grow on young birds are partially developed feathers just coming out of the skin, and are still enclosed by little horny sheaths which are afterward cast off.

Young birds usually change their feathers several times before they are full-grown. Afterward they cast off their feathers once, sometimes twice, a year, and replace them by new ones. When we think of the enormous amount of horny substance needed in the growing of new feathers at each molting, we can readily see why it takes so much energy, and why birds need special food at molting time.

Now that writers are no longer dependent on quill pens, feathers find their chief uses as ornaments and as stuffing for pillows, beds, and comfortables. Even feather beds are now seldom seen, except where goose feathers are plentiful. The downy feathers plucked in the spring from the breasts of geese, swans, and ducks are the best of the domestic supply of stuffing feathers. Chicken feathers stripped from their quills are also in demand. Before commercial use, they are thoroughly dried in ovens, to destroy disease and vermin.

FEB'RUARY. How does it happen that the second month in the year has but twenty-eight days, when all the rest have thirty or thirty-one?

To begin with, the Romans, who gave us our calendar, had but ten months in their year. At least their legends so tell us, and relate that King Numa Pompilius added two more months, one of which was February, with twenty-nine days. But Numa's calendar did not quite agree with the true timetable of the sun's annual journey. Each calendar year ended before the earth had quite completed its annual revolution, and by the time of Julius Caesar this slight yearly difference had amounted to a total difference of three months, so that the March equinox was occurring in the calendar month of June.

Caesar brought the calendar back into agreement with the sun, and, to keep it so, arranged that once in each four years (see LEAP YEAR), February should have thirty days. Julius Caesar's successor, Augustus Caesar, named the month of August after himself, and because he did not want his month shorter than the one which had been named after Julius, he took a day from February and gave it to August. So February was left with but twenty-eight days regularly, and twenty-nine in Leap Year. See CALENDAR.

FEDERAL BUREAU OF INVESTIGATION. See JUSTICE, DEPARTMENT OF.

FEDERAL FARM BOARD. See FARM RELIEF.

WHERE FIRST CONGRESS MET

In old Federal Hall in New York, the First Congress convened, and there George Washington was inaugurated as first President.

FEDERAL HALL. When the United States of America was a new nation, the first Congress met in Federal Hall, a large building on Wall Street in New York. It had originally been built in 1699 as the seat of the city government, but it was remodeled for the congressional session. The building was torn down in 1836 to make way for a subtreasury of the government, which now stands on the site. Federal Hall was the scene of the inauguration of George Washington as the first President of the United States.

FED'ERALISTS. In the early days of the independence of the United States, the members of the political group which favored a strong central government were called Federalists. They included such eminent statesmen as Alexander Hamilton, John Jay, and James Madison and fought for the adoption of the Constitution. The group came into power when Washington became President in 1789, then soon emerged as a political party. But the states'-rights forces won the election of 1800, and the party fell apart soon after its defeat of 1816. Later, the National Republicans, the Whigs, and the Republican party adopted many Federalist policies.

The attitude of the Federalists, led by Alexander Hamilton, was set forth in *The Federalist,* a series of eighty-five letters that appeared in a New York newspaper in 1787-1788. Written by Hamilton, James Madison, and John Jay under the signature "Publius," these essays were a brilliant defense of the Constitution and are still unsurpassed as a commentary on it. It has been said that *The Federalist* did more to bring about the adoption of the Constitution than any other thing except Washington's influence.

FEDERAL RESERVE BANKS AND BOARD. See BANKS AND BANKING.

FEDERAL TRADE COMMISSION. In 1914 Congress passed an act establishing the Federal Trade Commission, an agency of five commissioners appointed for seven years by the President, subject to Senate approval. Created to enforce the antitrust laws, it has been given much wider powers since 1938.

The agency is responsible for preventing unfair methods of competition, as well as unfair and deceptive acts or practices, in interstate and foreign commerce. It also informs the President, Congress, and the public about business conditions and practices and suggests legislation to protect the public. Its other duties include suppressing false and misleading advertising, prohibiting price and other discriminations, and enforcing certain other legislation against unfair business practices.

FEDERATION OF MALAYA, an independent nation of the British Commonwealth of Nations, is located on the Malay Peninsula of southeast Asia. Its northern neighbor is Thailand. Its area is about 50,690 square miles. It is one of the most vitally important areas of the Far East. Besides being the world's largest supplier of tin, it produces nearly half of all the world's natural rubber.

About four fifths of Malay is still a hot, humid jungle; most of the rest of it has been cleared and turned into rubber plantations. Malaya's other products include iron and manganese ores, tungsten and bauxite, rice, copra, palm oils, pineapples, tea, tapioca, pepper, camphor, timber, and fish from its almost-surrounding seas.

The Federation of Malaya became self-governing in 1948. It attained its independence August 31, 1957. It is composed of nine former Malay states, and the two former Straits Settlement colonies, Malacca and Penang. Its capital is Kuala Lumpur. The Federation is a monarchy. The Supreme Head of the Federation and a Deputy Head of State are elected by the rulers of the Malay states from their own number for terms of five years. The Parliament includes a Senate and House of Representatives. The ruler appoints the prime minister and can dissolve Parliament.

The Federation's 6,500,000 population is about 49 per cent Malay, 38 per cent Chinese, and 12 per cent Indian and Pakistani. The Malays, who are Moslem and the original inhabitants of the country, were opposed to giving non-Malayan-born Chinese citizenship in the country. The Chinese represent a powerful business group in the country, and the Malays were afraid of being ruled by them. The Malays would not permit Singapore to be added to their country because it was 80 per cent Chinese. The Chinese Communists were left with little strength after an intensive drive by the state. The Federation is a Moslem state.

FELD'SPAR, a name for several common minerals. It is a silicate of aluminum combined with sodium, potassium, calcium, or barium. All the common igneous rocks, including granite and gneiss, are largely composed of feldspar. Orthoclase, a potash feldspar, is used in making pottery glazes, as an abrasive in scouring soaps, and as a binder for other abrasives.

It is also a source of commercial potash.

Feldspar is mined, in North America, in North Carolina, Maine, New Hampshire, South Dakota, Ontario, Quebec, and several other areas. Colors of feldspar may be blue, pink, white, gray, and pale green. Some varieties exhibit beautiful monoclinic crystals. Feldspar rates 6 in the scale of hardness. See IGNEOUS ROCKS; MINERALS AND MINERALOGY.

FEL′LAH. This name is applied to any one of the laboring class in Egypt. It is an Arabian word meaning *peasant*. See EGYPT.

FELT. "It were a delicate stratagem," cried Shakespeare's King Lear, "to shoe a troop of horses with felt." Of all fabrics, felt is the simplest in construction and the most ancient. It is a compact sheet of entangled and matted fibers of wool or fur, which have been shrunken and pressed together with the help of heat and moisture. Felt is sometimes adulterated by the mixing in of cotton or other fibers which have no felting property and only cheapen and weaken the felt. While usually and originally not a woven or knitted fabric, felt is often made for certain purposes by the weaving or knitting of a coarse cloth which is then napped and felted.

The finest felts, made of fur, are used for hats, and the thinnest for glove linings, while the heavier or coarser kinds are used for table covers, pennants, saddle linings, insulators, slippers, filter pads, as covering for piano hammers, and for other purposes.

Felt varies in width from fifty-four to seventy-two inches. So-called *cotton* felt, or *table* felt, is a woven fabric which is also known as *silence cloth*.

FENCING. The first form of fencing was of Italian, French, and Spanish origin. The knights of these nations used long, heavy swords in battle. These were manipulated with both hands. A later form of combat was fought with the long, one-handed sword and a dagger for each contestant.

Today, fencing is rarely practiced in mortal combat; it has become an exercise to develop physical and mental qualities. It calls for excellent wind, agile legs and feet, the wrist of a D'Artagnan, a keen eye, and the possession of balance and timing. Moreover, a good fencer must plan ahead with the cunning of a Cyrano de Bergerac.

Probably the most widely used fencing weapon is the *foil,* or *fleuret.* It is slender and square in section, tapering to what would be a needle point if the springy steel were not flattened into a small, flat button. The button is rendered safer by being enclosed in a cemented tip of tape or resin. The slightly curved grip of the foil is protected by a convex bell of steel. Contestants wear wire mesh masks, pads covering the breast (*plastrons*), and gauntlets, as protection against injury.

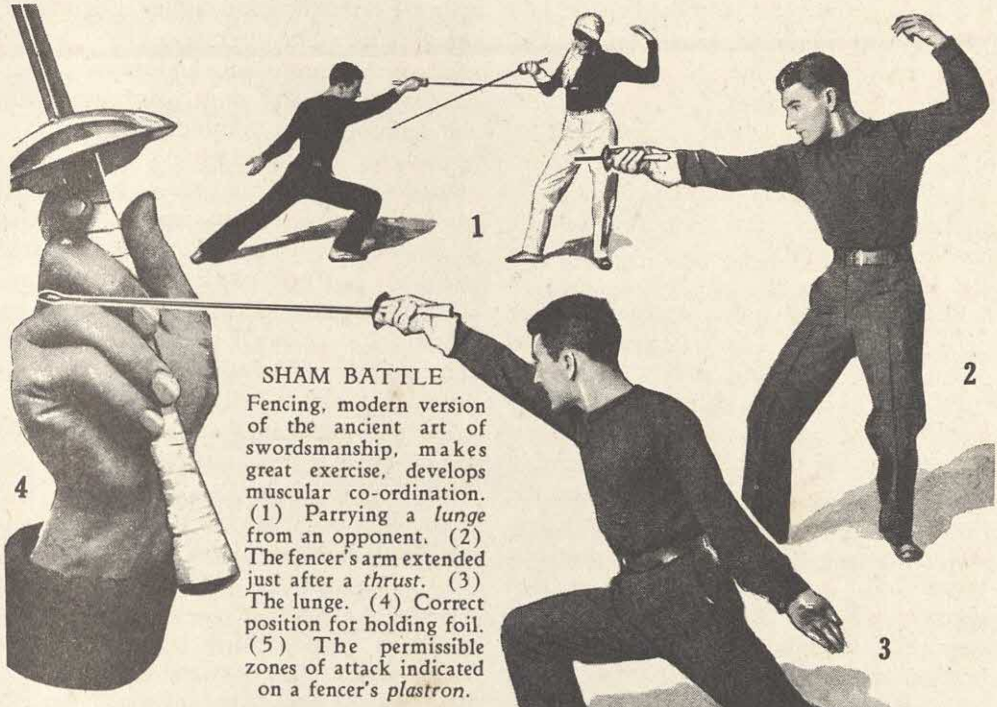
Matches begin with a formal salute. In the usual position of *on guard,* the body presents a right profile (for a right-handed fencer) to the opponent—the right foot forward in a straight line, the left back, at right angles to the forward foot, the knees bent. The sword-arm elbow is carried lightly close to the body, half bent. The left arm is carried behind for balance, bent at right angles, with hand above the head.

From this position three movements may be made: attack movements, called *thrusts;* defense movements, called *parries;* and *feint* movements, designed to mislead the opponent. A lunge toward the opponent is made with each attack movement. The essence of good fencing is to exercise caution and prudence before attempting a thrust, to be able to use the proper parry in blocking a thrust, and to confuse the opponent with feints. A point is scored when a *touch* (hit) is made on the opponent.

Besides the fleuret, the *epée,* a long, stiff sword, and the *saber* are popular for fencing.

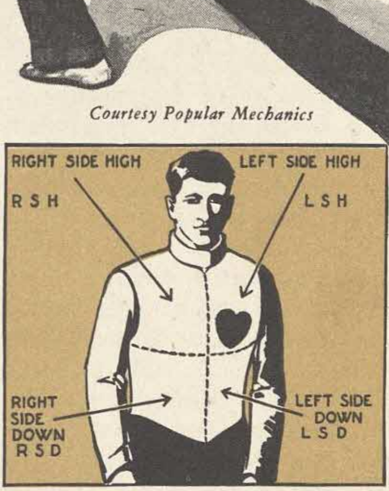
In broadsword fencing, blows are delivered from above, downward, in an attempt to make a hit.

Many colleges and universities now place fencing teams in competition, and fencing matches are a feature of the Olympic Games. See DUEL; SWORD.



SHAM BATTLE
Fencing, modern version of the ancient art of swordsmanship, makes great exercise, develops muscular co-ordination. (1) Parrying a *lunge* from an opponent. (2) The fencer's arm extended just after a *thrust*. (3) The lunge. (4) Correct position for holding foil. (5) The permissible zones of attack indicated on a fencer's *plastron*.

Courtesy Popular Mechanics



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FERDINAND V (1452-1516). It was the faith of Ferdinand V's queen, Isabella, in the plans of Christopher Columbus, that made them the rulers of a New World and gave to Spain a leading place among the nations of Europe. Ferdinand, king of Aragon, was the son of King John II. His marriage to Isabella of Castile in 1469 brought about a union between the two kingdoms that resulted later in a united Spanish kingdom. In 1481 Ferdinand made war against the Moors and, after ten years of bloody warfare, conquered Granada and drove the Moors from Spain. For this achievement he was awarded the title of "the Catholic" by the Pope. See SPAIN.

FERMENTA'TION. Vinegar, alcohol, chocolate, ripe cheese—these are just a few of the everyday articles of commerce produced by fermentation. This is a chemical process caused by *enzymes* built up by the growth of low plant forms such as bacteria, mold, yeasts, and fungi. The *turning* of milk, *working* of fruit juices, and *spoiling* of many foods are familiar examples of the process in operation. Canning, curing, and refrigeration are examples of the means people use to arrest the process.

Fermentation resembles the respiratory process of higher plants, for it liberates the chemical energy stored up in the substances acted upon, in the form of heat energy. Like respiration, it is also a tearing-down process by which complex materials are changed to simpler ones, but it usually differs from respiration in that the changes are less complete, and hence the amount of chemical energy changed to heat is also considerably less.

Splitting fermentations consist of chemical reactions which change the substance into two or more simpler substances by decomposition. They are the most common of the fermentations. When yeasts, through the enzymes which they manufacture, attack sugar, carbon dioxide and alcohol are formed. Different yeasts attack different sugars, and when ten to nineteen per cent of alcohol is formed, the reaction ceases.

Lactic-acid fermentation takes place as milk sours. When the product lactic acid, made from glucose, accumulates to the extent of eight per cent, the reaction ceases. *Butyric-acid* fermentation, to which the aroma of butter is due, *cellulose* fermentation, to which decay of wood is chiefly due, and many other fermentative processes belong to the splitting group of fermentations, though in many cases the process is very complex indeed.

In *oxidative* fermentation, oxidation actually takes place. When vinegar is made, oxygen attacks the alcohol and changes it into acetic acid and water. When ammonia or ammonium compounds are changed to nitrites and these to nitrates in the soil, the process is an oxidative fermentation.

FERNS. The delicate and graceful fronds of ferns provide a beautiful background for flowers and plants, and are always a delight, whether we find them deep in cool woods, or grow them in shady places of our gardens and greenhouses, or in the windows of our homes. Ferns are among the plants admired for their foliage, rather than for blossoms.

Ferns grow more abundantly in damp tropical climates than in cooler northern lands, and in the humid tropical forests, graceful tree ferns sometimes grow to forty feet or more in height. In mountain regions of the tropics, feathery ferns cover huge tree trunks with their green fronds, deriving their nourishment from the air. A study of fossils shows that, millions of years ago, there were everywhere larger ferns in greater numbers than in the tropics today, and indeed they were one of the principal vegetable growths of the earth. The coal that we burn today was formed from the carbon that was stored up by decaying prehistoric ferns.

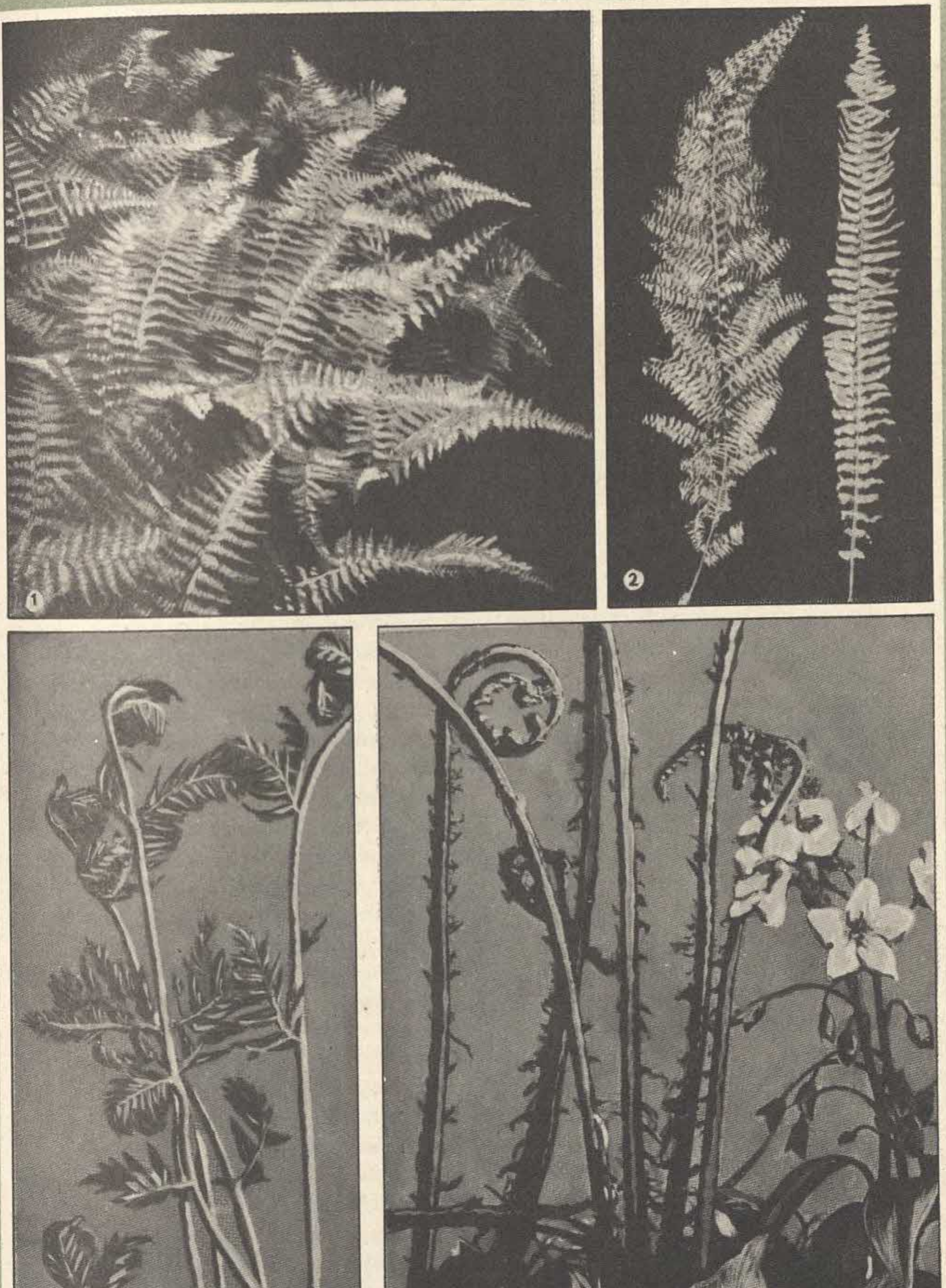
Ferns are the chief survivors of a great race of plants, the *pteridophytes* (Greek for "fern plants"), which existed before the flowering and seed-bearing plants developed, and are the highest representatives of the flowerless plant family. See BOTANY, page 474.

In most of the common types of ferns, the visible part of each plant consists of its leaves or fronds. The stem grows horizontally underground. In the tree ferns the stem grows erect. However, in both cases it is more complicated than any of the lower plants. While in some ferns all sections of the leaf bear spores, in others, including a number that are common in American woods, some sections do work with a green coloring matter called *chlorophyll,* and other sections produce spores. In this way different parts of the plant specialize in certain types of work, and thus we can see the beginnings of the habits of higher plants in which flowers are formed.

There are many types of indoor ferns, the most popular of which are the *Boston,* or *dagger,* the *holly,* and the *maidenhair* ferns. In addition to these, there are a large number which require more exacting conditions, so that their culture is limited to greenhouses. Some of them are the *bird's-nest,* the *Hartford,* the *staghorn,* and the *Pteris* ferns.

FER'RET. Now domesticated in countries far from its native Africa, the Old World ferret is a variety of polecat used for centuries to drive small animals such as rats out of their holes, to be killed by men or dogs. Ferrets are members of the weasel family.

The *black-footed* ferret is native to the Western Great Plains of the United States and is the largest American weasel. These ferrets are a pale-tawny color, and in their long, slender forms and swift, stealthy



NODDING GREEN GRACES OF THE FOREST FLOOR

With more than 4,000 different varieties, the ferns form the largest and most important family in the flowerless plant group. They grow in luxuriant profusion in the tropics, and there are large numbers in temperate zones. (1) A natural bed of boulder ferns in a wood. (2) Two members of the sword-fern family; the Boston fern (right), and the *Piersoni*. (3) Fronds of the royal fern in an early stage, with little resemblance to the full-grown plant. (4) Spring beauty and lady ferns combined.

UNDERGROUND HUNTER
Ferrets are valuable as vermin catchers.

movements closely resemble the common weasel, but are almost as large as a mink. They make their homes in deserted prairie-dog burrows and are seen occasionally as they go from burrow to burrow in quest of the prairie dogs. They probably feed also on such other small animals and birds or birds' eggs as they may be able to obtain.

FERTILIZA'TION OF PLANTS. Every seed produced in forest, field, and meadow is the result of the union of two kinds of reproductive cells, or *gametes.* This union is fertilization.

Fertilization also takes place in plants that do not bear seeds, the simplest plant form reproducing without it, but plants producing two kinds of gametes usually have fertilization as part of the life process.

Farmers would have no seeds were it not for fertilization, and had plants not developed the ability to fertilize quickly, farming would require even more patience than it now does. In the pine tree, fertilization does not occur until more than a year after pollen falls into the pine cone, but in many seed plants, fertilization follows only a few hours after pollination.

Fertilization in a Flowering Plant. A grain of pollen is a *spore,* or cell, from which a plant can grow. When one falls upon the *stigma,* or top of the *pistil,* of a flower, the cell's outer wall breaks and it begins to send a narrow tube downward into the pistil. This tube penetrates to the central part of the flower, called the *ovule.* Each grain of pollen and its tube constitute a tiny plant, just as truly as though they existed apart from the flower and grew in the ground. This plant is called a *gametophyte,* which means *gamete plant.* As it grows, it produces two male gametes.

Meanwhile, a spore which was produced in the ovule has also grown into a plant. This, too, is a gametophyte, but it produces a female gamete instead of male gametes. In the embryo sac the two types of gametes unite to form the seeds of new plants and also the *endosperm,* which will later be food for the seed when it germinates.

Fertilization within a pine cone takes place in virtually the same way as in the petaled flower.

Fertilization in Other Plants. In the lower plants, fertilization is not so complicated a process. In ferns there is but one kind of gametophyte, and it is not nearly so small as the gametophyte of seed plants. It produces both kinds of gametes. The male gamete is called a *sperm* and can swim, lashing itself about with tiny hair-like appendages. The female gamete, or egg, is produced within an organ called an *archegonium,* down the bottle-like neck of which a sperm must swim to fertilize the egg. In the mosses and liverworts the gametophyte is still larger, relatively, and the sperms are simpler, but are produced in large numbers.

In some of the fungi, a tube grows from the branch which produces male gametes, and penetrates the wall surrounding the female gamete. In algae the sperms and eggs may be produced upon branches that are very close together. When the sperms escape from their branch, some of them fall on the egg-bearing branches and reach the eggs within.

In all these plants, the fertilized egg grows directly into a new plant, which does not stop to rest in the form of a seed as it does with flowering plants.

Consult the following articles for additional information:

Botany
Cross-Fertilization
Germination
Pollen
Seeds

FERTILIZERS, *fur′ ti ly zurz.* Although there are areas in the United States and Canada where no commercial fertilizers are applied to the land, it is only a question of time until fertilizers become a necessity in all farming regions. For, under constant farming, many valuable elements are taken from the soil; and unless these elements are replaced by fertilizers, serious crop decreases result.

Early Fertilizers. Early Indians along the western coast of South America used the manure of sea gulls as fertilizer to stimulate the growth of their crops. The North American Indians taught the early settlers to place a fish in each hill of corn. Animal bones were also used for fertilizer in the early days.

As early as 1840, Justus von Liebig, a German chemist, discovered that acid phosphate could be made by treating bones with sulphuric acid. Since that time, a steady stream of nitrates, phosphates, sulphates, and potashes have been used as fertilizers. These substances are the ones needed by the soil in the greatest quantities. With the coming of the large meat-packing houses, tankage, dried blood, bone meal, and horn and hoof meal became popular fertilizers, especially in the Midwest.

Modern Fertilization. The chief cause of worn-out soils is the repeated raising of the same crops on the same land. This difficulty can be overcome by the rotation of crops, but the various crops used must require different kinds of food.

In spite of the new fertilizers that have been created, manure remains the leader on most farms. Clover, cowpeas, and soybeans gather free nitrogen from the air; consequently, in many places these crops are raised and plowed under, to rejuvenate the soil.

Nitrogen is found not only in manure and the clover and bean crops mentioned above, but also in nitrate of soda found in a free state in Chile, and in ammonium sulphate, a by-product of coke manufacture. Phosphorus for fertilizers comes from phosphate rock and bones. The potash used in the United States comes from domestic mines, chiefly in California and New Mexico. Calcium for the soil is obtained from wood ashes, air-slaked lime, burned lime, or ground limestone.

FESTIVALS, or FEASTS. Millions of people throughout the world celebrate each year the festivals of spring, of the autumn harvest, of periods important in religious life, and of national patriotic sentiment. The Jews have observed, from ancient times, six historical and sacred feasts: Rosh ha-Shana, the Feast of Tabernacles, Chamkah, Purim, Passover, and Pentecost.

Great Roman festivals included the Saturnalia, Cerealia, and Lupercalia. Among the celebrations of the ancient Greeks were the Olympian, Isthmian, Nemean, and Pythian national games, as well as the Dionysia, the Eleusiania, and a number of minor festivals.

The Roman Catholic Church celebrates many festivals, practically all of them originating in the histories of Jesus and the saints. Some of these festivals, in the Western Church, are Easter, Epiphany, Nativity, Christmas, Ascension, Pentecost, Annunciation, and Purification. The Church of England also designates most of these and a few others, as occasion for special services. Most of the Protestant churches observe only the weekly Sunday, Christmas, Good Friday, and Easter.

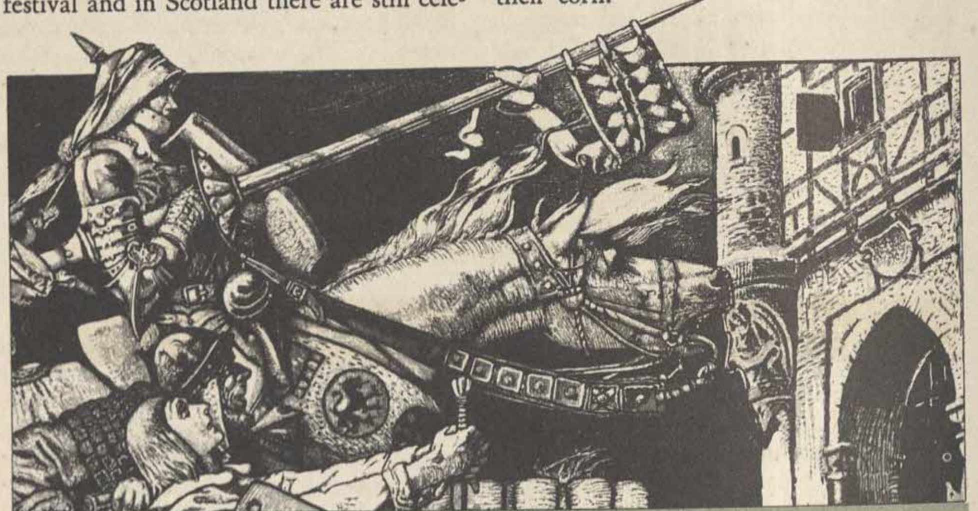
In the Church of England calendar, some of the saints' days were at one time marked in red, and these feasts were called *red-letter days.* The term is used today to describe memorable occasions. Our word *holiday* comes from the older term *holy day,* a day marked by church worship and departure from the week's routine of work.

The harvest festival is said to be the oldest and the most nearly universal of all feast days. It was quite human and natural, when the crops had been gathered, to tender the first fruits of the harvest in tribute to king, master, gods, or other protector, with appropriate ceremonial. In the United States, Thanksgiving serves as the national harvest festival. The first Thanksgiving was the Pilgrims' expression of gratitude for a plentiful crop from the new land.

Like our Thanksgiving, the harvest festivals of the ancient Greeks, the Roman Cerealia, and the Jewish Feast of the Ingathering came in the fall. Offerings of honey, oil, fruit, and grains were made and praise was sung to benevolent deities.

The English had their old harvest home festival and in Scotland there are still celebrations of the Kern festival. The Kern festival is held in a beautifully decorated church, and after the religious services are over, the feasting begins. Other festivals held at harvest time are Canada's Fete of the Big Sheaf, and the French festival of the Sheaves. Germany has its harvest home festival and Hungary holds celebrations in honor of the grape. Russia, China, and Siam also have harvest festivals which are accompanied by feasts and games and parades.

Almost all of the American Indian tribes had their harvest celebrations in honor of their corn.



The AGE when MIGHT was RIGHT

FEUDAL, *fu' dal,* **SYSTEM.** During the Middle Ages there developed in Europe a social system based on land tenure, or landholding. This system, called the *feudal system,* or *feudalism,* came into existence in about the fifth century and lasted for a thousand years; in some countries, however, the feudal system extended even into modern times.

True it was that during this era of rule by force magnificent cathedrals were constructed, formidable castles were built, knighthood flourished, and nobles and princes lived in comparative luxury and splendor. But at the same time, thousands of people lived in poverty and ignorance and fear. Wars were frequent; agriculture was little developed; communication, even among villages a few miles apart, was difficult, for there were few roads. Sickness and disease were rife.

How It Came About. In the fifth century the great Roman Empire fell apart when barbarians from the north and east swept through Europe, plundering and ravaging. Chaos replaced the orderly rule of the Romans; and the people, seeing their lands and property destroyed, had no

THE CHURCH WIELDED VAST POWER IN FEUDAL DAYS
Chivalric codes were closely linked with religion, and knights often received blessing.

strong central government on which to depend.

Strong men built castles on inaccessible islands and hills to defend themselves. Weak men came to them and offered their services as tillers of the soil in exchange for protection, and became *vassals* of the lords. Villages grew up around the castles, and walls were built around the manors, as the settlements were called. The weaker men did the work; and the lords, as the strong men were called, and their retainers did the fighting. Thus the feudal system, born of fear and fed on the power of the sword, spread over Europe.

How the System Worked. The great nobles received their land grants, or *fiefs,* from the king and were, therefore, vassals of the king and owed him allegiance. They lived in the big castles and governed all the land within their control. These nobles, in turn, might divide their fiefs into smaller units under lesser nobles, who did homage to them. Finally, the land was divided into still smaller units to be tilled by the common people.

The people who tilled the soil came to be divided into two classes, *serfs* and *villeins*. The serfs were little more than agricultural slaves who tilled the soil and received only a bare living from their crops. They were not allowed to leave their land, and their children could not marry the children of serfs of another domain. If a serf had no children, his land passed to the noble when he died. Villeins were a little better off. They had more freedom and received a larger share of the crops. As the years went by, both serfs and villeins became subject to military duty, and such duty was frequent because of the increasing desire of the lords for power and conquest.

Such a system as feudalism greatly weak-

THE AGE OF FEUDALISM KNEW NO PEACE

Medieval lords were perpetually at war, so all towns had to be fortified. The only entrance to these communities was by the drawbridge which crossed the forbidding moat.

ened the power of the king. It was the great nobles to whom the mass of the people owed their allegiance and on whom they depended for protection. So the king did not actually rule over all the people in his kingdom.

How the Bonds Were Broken. The Crusades brought men from all the little duchies and kingdoms together, taught them new things, and gave them new ideas. They stimulated trade, which led to the growth of the towns and the building of roads. The Crusades further weakened the feudal system because many of the lords lost their lives during the wars. And many of those who returned lost their lands or were impoverished because they had borrowed money from the towns to finance their ventures. The nobles who were heavily in debt were forced to extend freedom to the towns in exchange for the money, and, in time, a money economy replaced the land economy, which was the heart of the feudal system. The growth of towns meant that the people no longer had to depend entirely on the lords for protection; and a class of industrial workers arose, strong enough to become independent of the feudal lords. All these things helped to break down the feudal system.

Another force that helped to destroy feudalism was the Black Death, a plague oc-

THE RULE OF FEUDAL LORDS WAS HARSH

Farmers and peasantry in the Middle Ages were in virtual slavery to their barons. They were not allowed to fence off the land, so livestock often ruined their gardens.

curring in the 1300's. Many thousands of persons died of the dread pestilence. The lords, in order to have their lands cultivated, were forced to give benefits to the peasants and to pay them better than before. Thus the serfs achieved a degree of freedom. The need for labor, created by the plague, brought the peasants, who wished to break away from the manors, pouring into the towns, and business and trade were further stimulated.

Gunpowder, which came into use in the fourteenth and fifteenth centuries, also helped to break down feudalism. With firearms, the small forces of the castle were replaced by standing armies; and as the standing armies grew more powerful, nations assumed more power and a feeling of nationalism spread among the people. Castles and walls and armor could not withstand guns, and so were no longer of use. With money instead of land becoming the basis of wealth, a middle class arose to overthrow the domination of lords over the common man. The kings, too, were opposed to feudalism.

FEUDALISM'S ONLY GUARDIANS OF CULTURE

Monasteries flourished during the period, and in them the monks kept their illuminated manuscripts—the only "books" of the day. Monks also were the only teachers.

The invention of printing in the fifteenth century was another element in the destruction of feudalism. Cheap books inspired the thirst for knowledge that paved the way for the Renaissance. People began to read, and thus to think, and it was impossible for a system founded on ignorance and fear to withstand knowledge and truth.

For all these reasons, feudalism began to disappear. Gradually it gave way to a new social order and ceased to exist.

Consult the following titles for additional information:

- Abbey
- Armor
- Castle
- Catapult
- Cathedral
- Charlemagne
- Chivalry
- Crusades
- Guild
- Manor
- Middle Ages

FI′AT MONEY. Fiat money is paper currency or metal coins whose real value is less than the value stamped upon the face. During the War between the States, for example, the United States issued greenbacks which the fiat, or order, of the government made legal. These notes had no backing except the government's promise to pay. Paper currency, backed by precious metal reserves, is not fiat money. See Greenbacks; Money.

FIBER is a threadlike object. It comes from the seeds and stems of plants, from the hair of animals, and from minerals. Today man makes a host of synthetic fibers, some of which are more useful than natural fibers. From fibers in woven or textile form, man has gotten his clothing and coverings of all sorts. Fibers have furnished man binding in the form of thread, rope, cable, and wire. They have made bristles for his brushes. In their pressed form, they have given him paper in order to communicate his thoughts and to make packaging of all types. Today pressed fiber forms important building materials.

Important textile fiber plants are cotton, flax, hemp, and jute. Wool, from sheep, alpacas, and goats, and silk from the silkworm are animal fibers. Asbestos is a natural mineral fiber. Synthetic fibers are derived from both plant and mineral products. The cellulose products rayon, acetate, and Arnel come from wood pulp and cotton. Nylon is made from coal, natural gas, and petroleum; Orlon, Acrilan, and Dynel from coal and limestone; and Dacron from coal and petroleum. Saran comes from petroleum and salt, and vinyon from soft coal and salt.

Sisal, manila, henequen, and palm fibers are hard fibers which make cables, ropes, and roughly woven bags. Synthetic nylon, vinyon, and saran today make strong cordage. Steel wire is probably the most useful strong fiber made by man. For brush bristles, nylon has largely replaced hog hair and tropical plant fibers.

Fiberglas can be spun into cloth, is used for insulation, and strengthens plastics. Fiberboard, from pressed wood and plant fibers, is a great building aid.

Straw, from wheat and cereal plants, and tropical plant fibers such as bamboo, rattan, and cane, have been used for centuries to weave hats, baskets, and mats. Straw has been a valuable packing aid.

See also the following articles:

- Asbestos
- Cane
- Coir
- Cotton
- Flax
- Hemp
- Jute
- Linen
- Palm
- Silk
- Silk, Substitute
- Sisal
- Wool

FID′DLER CRAB, a small crab living along beaches. The male has one peculiar, violin-shaped claw from which the crab gets its name. The creatures live in small burrows, gathering in marshes in large numbers. They are quite harmless, living on sea plants and grasses. They have a funny, sidewise gait, but when frightened make good speed in trying for the nearest burrow.

FIEF, *feef.* See Feudal System.

FIELD, Cyrus West (1819-1892). A firm belief in the value of quick communication between the Eastern and Western hemispheres led Cyrus W. Field, wealthy New York merchant, to persist in the promotion of an Atlantic ocean cable until he saw it completed and ready for regular service.

Cyrus Field was born in Stockbridge, Mass., and began his career as a merchant in New York City. He was sufficiently successful in this business to retire from it at the age of thirty-four. Securing a fifty-year charter which gave him the right to land ocean telegraphs on the coast of Newfoundland, he organized English and American telegraph companies. Several attempts to lay the cable were made in 1857 and 1858, and in August of the latter year, one completed span sped the first "electric words" over the bed of the Atlantic. This cable broke in a few days, and the start of the Civil War interrupted further efforts to unite Europe and the United States by underseas telegraph. After the war, Field used the *Great Eastern,* the largest steamship afloat, to lay a lasting cable, which was completed on July 27, 1866.

Later, Field helped establish cable communication with the West Indies and South America and was identified with railroad promotion. His brother was Stephen J. Field, noted Supreme Court Justice. See CABLE, SUBMARINE.

FIELD, EUGENE (1850-1895). A poet who knew and loved children, a humorist who could make people laugh and forget trouble —this was Eugene Field, widely known as America's most-beloved children's poet. His poems range from the fanciful appeal of *Wynken, Blynken and Nod* to the humorous, in *Seein' Things* and *Jes' Fore Christmas,* and to pathos in *Little Boy Blue* and *Sometime there ben a lytle boy.* That he understood the problems and desires of childhood is shown in *The Limitations of Youth.* Because of the simplicity of his style, children understand and enjoy him; their elders appreciate the sympathetic understanding of the problems and hopes of children. These qualities—his sympathy and understanding—have made Field's poems widely read and long remembered.

Field was born in Saint Louis, Mo., but after the death of his mother, he lived with a cousin, Miss Mary Field French of Amherst, Mass. He first studied at Williams College and later at Knox College, Galesburg, Ill., where he remained a year. After completing his education at Missouri State University, at Columbia, Field went to Europe.

POET OF CHILDHOOD
Eugene Field's works are beloved of all.

Faced with the necessity of earning a living after his return, Field turned naturally to his one great interest—writing. This guided him into journalism, first as a contributor to the Saint Louis *Journal,* a paper of which he later became city editor. From there, he continued his journalistic career on papers in Denver, Saint Joseph, Kansas City, and Chicago.

It was in Denver that Field first gained recognition as a literary figure, when he published a group of humorous newspaper articles. In 1883 he was invited to conduct a column called "Sharps and Flats" for the Chicago *Morning News.* At this same time, he also achieved considerable distinction as a lecturer.

Field's reputation rests mainly on his children's poems. He also wrote many larger works, among them *The Model Primer, A Little Book of Profitable Tales, A Little Book of Western Verse, Echoes of a Sabine Farm, With Trumpet and Drum,* and *The Love Affairs of a Bibliomaniac.*

FIELD GLASS. It is a fascinating pastime to study the homes of birds, to observe every detail of their daily activities, to watch the downy babies get fed and grow strong enough for the first flight—all without

LONG-DISTANCE EYES
Field glasses make foreground of background.

moving from your easy chair. It is possible to get close to bird life in this way with a pair of field glasses, twin telescopes arranged for easy focusing.

The simplest field glass is a Galilean telescope, in principle the same as the opera glass described in the article Telescope. A more powerful glass is the *prism binocular*. This is sometimes referred to as the *binocular*, but as this name means merely *for two eyes*, it applies equally well to the opera glass. In the prism binocular, use is made of the principle of total *internal refraction* explained in the article on Light. The light which enters the barrel of the glass passes into a right-angle prism, is bent to one side, then refracted back in the general direction of its source. At the fore edge of the instrument the light is intercepted by a second prism which again refracts it to the side and then toward the eye.

The effect of the prisms is to make the path of the light three times as long between the outer and inner lenses, thus increasing the magnifying power without making the instrument of unwieldy length. The lenses are *converging* (see Lens), and an extra lens for making the image right-side-up is not necessary, as in the land telescope.

A good field glass should cost in proportion to the quality of its lenses and its magnifying power. The best binoculars have a separate adjustment for each eye for greater accuracy.

FIELDING, Henry (1707-1754). One of the first masters of the realistic novel, Henry Fielding is listed among England's greatest story-tellers. He gave his characters a flesh-and-blood reality because he believed that life should be pictured as it actually is. Thus, some of his passages are harsh; nevertheless, he showed great sympathy for the shortcomings of men. His finest work, *Tom Jones*, appeared in 1749 and immediately set a new style for novel writing. Portraying the incidents in the life of a young foundling, this novel was a true picture of life in eighteenth-century England.

Fielding was born in Sharpham Park in Somersetshire and was educated at Eton and Leyden. He began his career as a writer by turning out several unsuccessful comedies. Shortly after, he married a Miss Craddock; but when he had dissipated her fortune and his own, he returned to writing as a profession. Among his other novels were *Joseph Andrews*, *Amelia*, and *Jonathan Wild*.

FIELD MARSHAL. See Rank.

FIELD OF THE CLOTH OF GOLD. Silk and satin, precious jewels, and luxurious trappings marked the meeting, near Calais in France, in June, 1520, of two of the mightiest monarchs of Europe, Henry VIII of England and Francis I of France. Because of the gorgeous splendor of their followings, the place of meeting became known as the *Field of the Cloth of Gold*. The event was intended to cement a "peace" between the two nations, but, as in many similar cases, such an extravagant meeting of the golden lion and the *fleur de lis* had little effect.

FIFE. When Shakespeare wrote of the "ear-piercing" fife and the "vile squealing of the wry-necked" fife, he was describing an instrument probably 2,000 years old in his day.

The fife is a shrill flute which formerly was always cylindrical, but which sometimes has a conical interior in its modern form. Some fifes have keys, like a flute, but in the historical form, the wind holes are stopped only by the fingers. The fife and drum corps was the forerunner of the military band.

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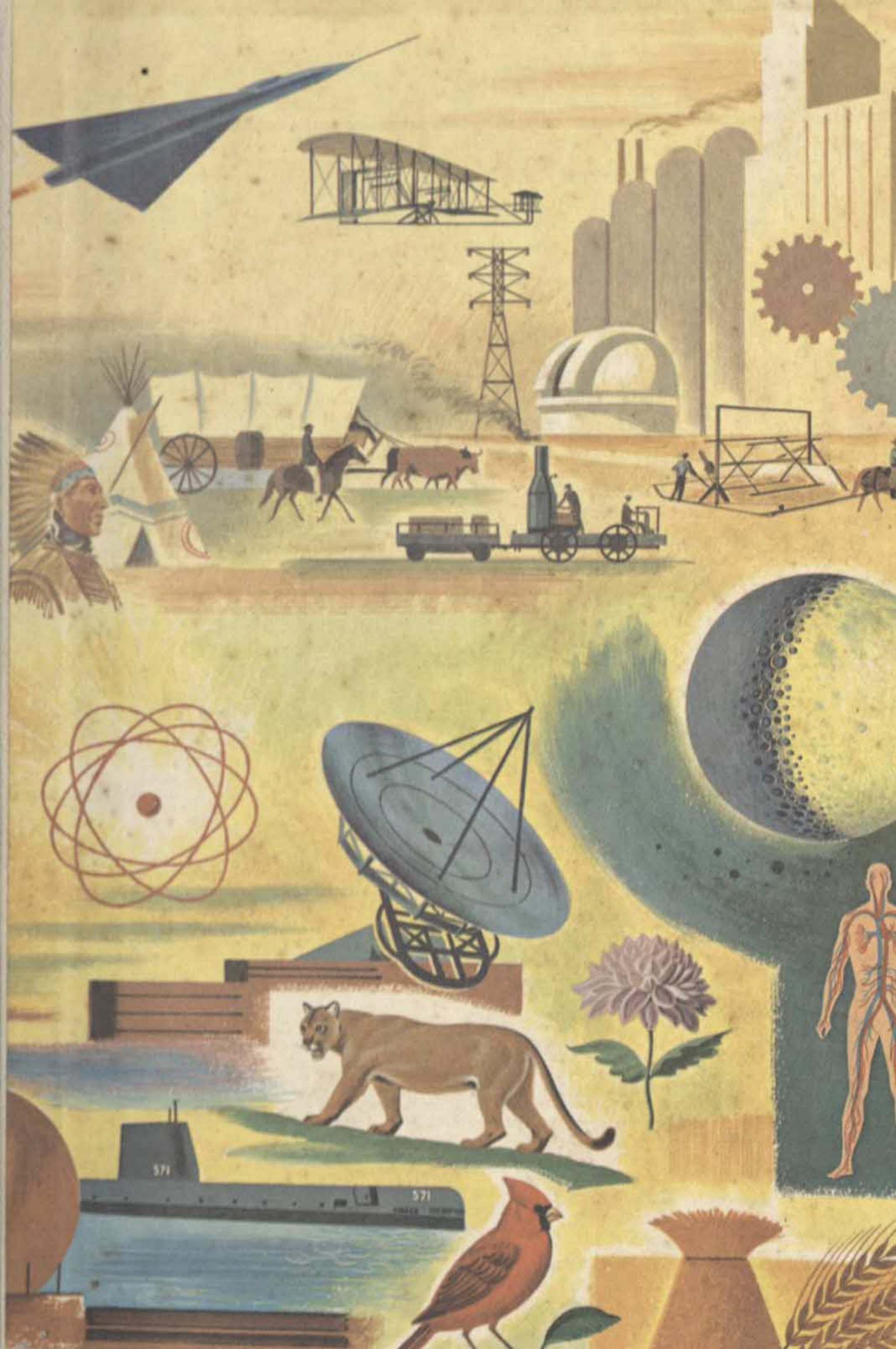
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